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FLIGHT

AIRCRAFT, SPACECRAFT, MISSILES

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The First Round

BAD news came to Britain last week with the announcement of a £125 million order, on behalf of Eastern Air Lines and United Air Lines, for 80 Boeing 727 short-range jet airliners. Bad because this business might have come the way of the de Havilland Trident. Bad because the 727 is a near-replica of that remarkable British aeroplane. Bad because the Pratt & Whitney turbofan engines specified by both American operators follow very closely the design of the Rolls-Royce unit, which is Boeing's preference. Worst of all, this vast American domestic order has dealt a blow of great severity to the Trident's prospects not merely in the USA but in the markets of the world. The blow was not unexpected, however, for as each day passed it was becoming clearer that this tremendous stroke of business was not contingent on technical considerations alone, but on finance and politics. The blow, moreover, wins only the first round in a continuing bout of buying.

But the going has suddenly become much tougher. The men are being sorted from the boys by a set of rules that disregard everything except commercial advantage. Where there might have been co-operation there is now developing a slugging match—what Mr J. D. Pearson of Rolls-Royce described the other day as something approaching a fight for survival. The dollars are staying at home, and the door is being shut. To apportion blame for this state of affairs —if blame there is—would be to ignore the increasing frictions of a competitive world. Germany's Hamburger H.F.B. 314 has already taken the count.

Is it Cheating?

Some comment has been made in the national Press on the "copying" of the Trident's triple-jet formula, though perhaps without regard for history. It would be hypocritical not to admit that at the time of the great Bristol 200/D.H.121 controversy there was wide agreement that in physical make-up the two designs were well-nigh identical for the same sound technical reasons. There would be even greater hypocrisy in failing to recall that at one stage of its design career the Sud Caravelle had a third engine. Nor was it in respect of an American aircraft, but a British, that Sud were able to quip "Oh! ils ont copié Caravelle." Nevertheless, we believe that Boeing and Pratt & Whitney have been definitely influenced by British techniques. Just as the great Seattle company improved the flying characteristics of their 707 in recognition of British requirements, so we believe it will acknowledge, if not a debt, then some degree of help from de Havilland.

Immense though they are—between them they constitute the biggest single transaction in the history of transport—the initial 727 orders represent only a proportion of the business to be done in the short-haul jet market. Eighty aircraft have been sold; yet Boeing's president, Mr W. M. Allen, declares that the company will need to sell 200 before they start to make money.

It would be some consolation, in face of the commercial misfortunes we have detailed, if there were prospects that advanced British techniques would prove saleable where our commercial aircraft have been unsuccessful. This may yet come to pass, though there is scant evidence of it in reflecting upon two special articles in this issue—one on vertical take-off and landing, the other on boundary-layer control. Britain has led in the development of practical VTOL systems, just as she has shown the way for usable applications of BLC. Yet what we have had to say above, jointly with what is known of American intentions, does nothing to brighten a bleak prospect—one that can only brighten, indeed, with the receipt of export orders on a massive scale.

ALL-WEATHER PATTERN set by Javelin FAW.5s, Canberra T.11s and Meteor NF.14s of No 228 Operational Conversion Unit, the work of which unit is described in an article on pages 949-952 of this issue "Flight" photograph

FROM ALL QUARTERS

High-level Exports

AVIATION exports for the first ten months of this year, at £116,940,256, exceeded every post-war annual figure with the exception of those for 1958 and 1959. The post-war total now stands at £1,059,038,111, of which some £650m has been earned over the last five years.

October exports come to £8,654,090, made up as follows: aircraft and parts, £2,308,199; aero-engines and parts, £5,827,177; electrical equipment, £271,837; instruments, £185,629; and tyres, £61,248. The US were the largest buyers of aircraft and parts, spending £343,806, followed by India (£235,127), Canada (£183,568) and West Germany (£101,524). The US were also the largest buyers of aero-engines and parts (£1,568,883), followed by France (£917,861) and Canada (£661,533).

Mirage v Draken

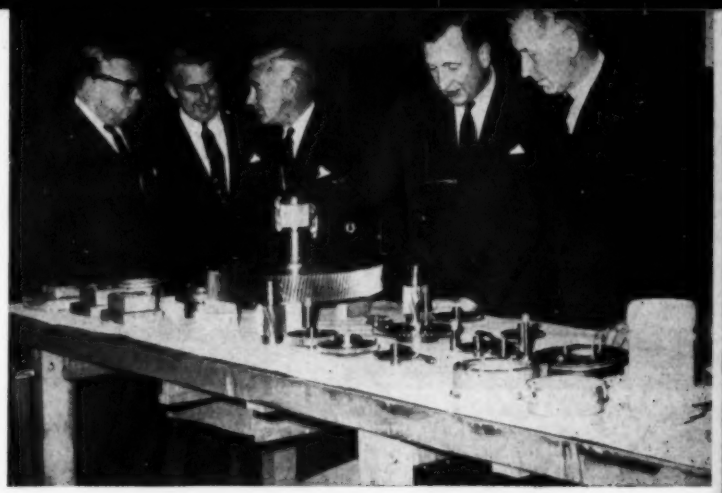
OF the few international military-aircraft competitions still to be resolved, one of the greatest is that for a new combat aeroplane for the Swiss Air Force. From a wide range of types the field has now dwindled to two: the Dassault Mirage IIIC and the Saab Draken. Examples of both engaged in rival demonstrations in Switzerland during the second half of November. Dassault sent three aircraft: a pre-production IIIA, a two-seat IIIB and the first production IIIC, which flew on October 10 and was delivered to the Armée de l'Air on October 31. Saab sent a single J 35B.

During demonstrations at Lucerne/Emmen the Mirage was flown by Capt Jean Coureau and the Draken by Seylon Utterborn. Later on the same day two Swiss pilots, Maj Moll (Mirage) and Haupt Weber (Draken) fired on the range at Alpnachersee, after which handling tests were conducted from Meiringen, in the narrow Aare valley in the Bernese Alps. The Draken proposed for Switzerland incorporates minor modifications, and is designated Saab-35H (Helvetia). A decision between the two aircraft will be made by the Bundesrat before next spring.

New ETPS Award

AN American pilot, Lt Cdr Lloyd Hoover of the US Navy, won the McKenna Trophy for being the best all-round student on No 19 Course at the Empire Test Pilots' School; it was presented to him at the McKenna Dinner at Farnborough on December 8 by the principal guest, Sir George Gardner, Controller of Air-

FIFTIETH ANNIVERSARY of Sir Thomas Sopwith's gaining his RAeC certificate was celebrated on December 1, when the directors of the Hawker Siddeley Group honoured their chairman at a dinner in London. He was presented with a model of the Howard Wright biplane on which he took his ticket. Seen here at the reception are, left to right, Sir Halford Reddish and Mr Harold T. Chapman (directors), Mr Hugh Burroughes (deputy managing director) and Sir Thomas



***MINISTRY AND MANAGEMENT:** During a visit to the de Havilland Engine Company to inspect work in progress for the MoA, Rear Admiral J. A. Ievers, Deputy Controller of Aircraft (Military) was shown assemblies from the Coupled Gnome gearbox that is being developed on behalf of the Ministry for the Westland Wessex Mk 2—which may fly early next year—and is also suitable for a projected Mk 3. Talking to Admiral Ievers is Mr Hugh Buckingham, managing director of the D.H. Engine Co. Others in the picture are, left to right, Mr W. F. Shaylor (sales director), Mr G. N. Pollock (general works manager) and Dr J. W. Drinkwater (Director of Engine Research and Development, MoA)*

craft at the MoA. Sir George also presented the Edwards award (which goes to the course member who is considered to have done best to improve himself at the school), to Flt Lt G. M. Morrison; and a new award, the Hawker Hunter Trophy, was presented by Hawker Aircraft chief test pilot Bill Bedford to Flt Lt I. H. Keppie.

The ETPS commandant, Capt Ken Hickson, said that No 19 Course had achieved a higher level than any past courses: there had been three distinguished passes, competition had been hot throughout and only one-half per cent in marks separated the trophy winners and runners-up. The future of the school was more or less established; test pilots would be required as long as there was flying at Boscombe Down, Farnborough and Bedford.

Sir George, recalling famous names, echoed this sentiment: as long as a need for test pilots existed, there would be a need for the ETPS. And Bill Bedford, in a characteristically thoughtful speech, said that the award of the Hunter Trophy was particularly pertinent in view of the work done at the school in overcoming the "bogy" of spinning and recovery in swept-wing aircraft and in furtherance of the inverted-spinning programme.

***SOVIET TEST PILOT** Constantin Kokkinaki, for whom, as recorded last week, a 100km closed-circuit record of 2,148.3km/hr (1,335 m.p.h.) is being claimed. His aircraft was reported as an E-66 delta, similar to that flown at 2,388km/hr last year by Georgi Mosslov. Kokkinaki is now 50, and has been a test pilot 24 years*

Hawker History

THE annual reunion dinners of the Sopwith Apprentices Association—the sixth of which was held last week at the Royal Aero Club—always attract a distinguished gathering, if only because so many of the members are men who have in later years made their mark either in the aviation industry or in other activities. The president is Sir Thomas Sopwith; from him the company expected some entertaining reminiscences, and were not disappointed. We particularly liked his recollection of a flight from Martlesham in the Hawker Tomtit, with Maj (later Gp Capt) P. W. S. ("George") Bulman. Sir Thomas, who had last flown an aeroplane 16 years earlier, was invited to do the take off. Near-disaster followed, for (in his own words) "In no other conveyance would you push your right foot forward to go to the right."

Mr J. T. Lidbury, Hawker managing director, giving a Sopwith-Hawker history to "put the record straight," said that from May 1933, when Hawker Aircraft Ltd was formed, 26,000 aircraft had been built to their designs, including 1,000 Harts, 13,000 Hurricanes and 2,000 Hunters. Of 50 types, 21 were prototypes only, leaving 29 to go into production. Then Mr Lidbury went on to quote some prices—"in very round figures": Hart, £2,200; Hurricane, £7,500; Hunter, £120,000; and P.1127, £250,000 ("with a big query mark"). Prices of engines had been somewhere in the region of £2,000 for the Hurricane [Merlin] and £40,000 for the Hunter [Avon]; cost of the P.1127's powerplant [ES.53] was "well, mind your own business." In the days of the Hawker Engineering Co the annual turnover was £200,000; last year's Hawker Aircraft figure was £25m. Personnel numbered 1,750 then, between 4,000 and 5,000 now.

Additional contributions to the evening, from various other well-known members and guests. were equally educative but in the main less quotable.

"Flight" photograph

***SCREEN TEST:** Seen at the business end of the impressive Xenon slide projector in the projection room of the Royal Aeronautical Society's new lecture theatre are Mr A. J. Barrett of the technical department (left) and Dr A. M. Ballantyne, secretary of the Society. The projector was developed by Robert Rigby Ltd and AEI Sound Equipment Ltd*

IN BRIEF

Rolls-Royce Ltd are to commission a stained-glass window in Westminster Abbey in memory of Sir Henry Royce, who died in 1933.

Mr Dennis Hennessy, chairman of Hovercraft Development Ltd, who is visiting Australia, said recently that the SR-N2 is to be demonstrated in Australia within 12 or 18 months. Four of the present designs which have been produced in England might be suitable, he added, for carrying stock in inland Australia.

The late Lt Cdr J. R. S. Overbury was stated in our obituary notice (November 25) to have completed the SR.53 prototype trials as chief test pilot of Saunders-Roe Ltd. He was not in fact appointed to this position, and the trials were concluded at Boscombe Down last year by Lt Cdr P. M. Lamb, chief test pilot (fixed wing aircraft) of the Saunders-Roe Division of Westland Aircraft Ltd.

The automatic stabilization and flight instrumentation system for the Hawker P.1127 is being developed by Sperry and the Smiths Group. Sperry are the team leaders and Smiths Aviation Division and Kelvin and Hughes are collaborating in the provision of parts of the instrumentation and control system. This arrangement continues the pattern set for the D.H.121 Trident, on which the Smiths Group are the team leaders and Sperry are collaborating.

Ultra Electronics Ltd are to purchase a third share in Miles Electronics Ltd, with the intention of widening the scope of the two companies' activities. They jointly designed and manufactured Sea Vixen aircraft and radar simulator equipment and are currently developing an aircraft and radar simulator for the Buccaneer. Mr A. V. Edwards and Mr L. R. Crawford, directors of Ultra Electronics, will join the Miles Electronics board.

Mr Geoffrey Worrall, formerly chief production test pilot, has been appointed chief test pilot of the Gloster Aircraft Co Ltd. This follows the transfer within the Hawker Siddeley Group of Wg Cdr R. F. ("Dickie") Martin, Gloster chief test pilot for the past six years, to the test pilot staff of A. V. Roe & Co Ltd at Woodford owing to the reduction in flying requirements of the Gloster Aircraft Co. Geoff Worrall, who is 38, joined Glosters from the RAF in 1946 as technical representative and was transferred to the company's test pilot staff in 1950.

Canadair Ltd have appointed four new vice-presidents. Mr C. F. Fincham, formerly assistant to the president, becomes vice-president military relations; Mr K. H. Larsson, previously director of commercial aircraft sales, has been made vice-president sales in charge of commercial sales for all areas other than the North American continent; Mr J. A. Morley, formerly cargo systems co-ordinator, becomes vice-president sales in charge of all commercial sales on the North American continent; and Mr G. C. Keefer, previously director of contract administration, has been made vice-president administration.

BOEING 727

US Competitor for the D.H. Trident Announced

Similarity of the Boeing 727 to the D.H. Trident Mk 1 is evident from all three angles, as the general arrangement drawings in col 1 below (to the same scale) show. The most noticeable external difference, especially in plan, is the Boeing 727's longer tail arm achieved by the taller swept fin. These two pictures are roughly to the same scale also

"The Boeing 727, newest member of America's first family of jet airliners, is a short-haul airplane designed for use on flights with many stops, serving airports where much of the world's commerce begins and ends."—George R. Sanborn, Boeing Airplane Co Transport Division.

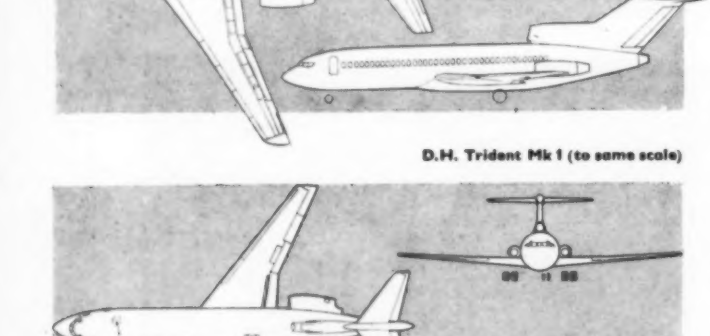
AS expected, Eastern Air Lines and United Air Lines have each placed an order for 40 Boeing 727s, and Boeing have considered this sufficient to proceed with the project. The signing of the contracts was announced by Mr William Allen, Boeing's president, on Monday, December 5. The order is valued at "more than $350m" (£125m) and is believed by the American company to be "the largest order in the history of transport." The United order, say Boeing, is for 20 aircraft with the second 20 automatically becoming firm either "when the Capital Airlines-United Air Lines merger is consummated, or upon achievement by United of certain project financial ratios."

First deliveries to these two airlines are to start "in late 1963" and the first aircraft, says Mr Allen, will be flying in March 1962. The following table compares the time-scales of the Boeing 727 and the D.H.121 Trident Mk 1:—

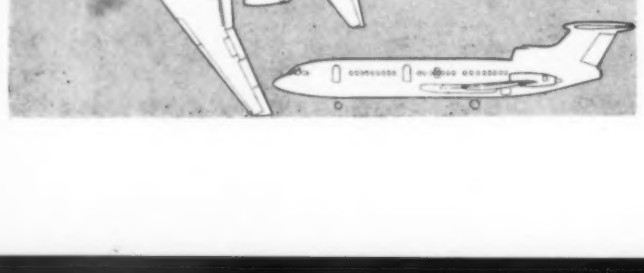
	Boeing 727	D.H. Trident Mk 1
Initiation of studies	Summer 1956 ("4½ years ago")	Summer 1956 (BEA spec. issued July 1956)
Start of design	June 1959	February 1959*
First contract signed	December 1960	August 1959
First flight	March 1962	December 1961
Certification and first delivery ...	December 1963	June 1963
Time from start of design to first flight	1yr 9m	2yr 10m
Time from first flight to certification and first delivery	1yr 9m	1yr 6m
Time from start of design to first delivery	3yr 6m	4yr 4m

* Start of revised design, the original D.H.121 having grown too large for BEA's requirements.

Boeing 727



D.H. Trident Mk 1 (to same scale)



Put another way, had an order for the Boeing 727 been signed in August 1959, at the same time as the BEA order for the D.H. Trident, the first Boeing 727 would have been flown last month. The Trident's late start was due to the long drawn-out political controversy in 1957, when the Government used the BEA order in an attempt to reshape the aircraft industry, costing perhaps a whole year in the Trident programme.

Comparisons with the Trident Mk 1 must be made with reservations: the 727 is a bigger, more powerful, longer-ranging airliner, more comparable perhaps with the Mk 2 development of the Trident, about which no details have yet been announced.

An important commercial difference between the two aircraft is the provision in the 727 of a rear ventral passenger door, *à la* Caravelle, compared with the Trident's fuselage-side door just forward of the wing. Both aircraft have a passenger entry door aft of the nose section.

Powerplant installation of the 727 appears to resemble very closely that of the Trident, except that reverse thrust is provided on all three engines instead of, as in the case of the Trident, on the two side engines. According to Boeing the installation of the powerplant is "the best way to place three engines on an airplane such as the Boeing 727." All other possible methods were explored, including the asymmetric fuselage side installation of two on one side and one on the other; three engines grouped around a butterfly tail; three engines grouped around the twin tail; and two underwing pods and a third engine in the tail. Boeing's decision to adopt the Trident installation represents a major breakaway from their underwing pod philosophy going back 15 years to the XB-47. The advantages claimed by Boeing for the final choice echo those made by D.H. over the past two or three years, and inevitably "unsell" underwing pods:—

"The rear body installation also leaves the wing clear so that high lift devices can be installed for the short take-off and landing runs required in short-haul service. An obvious advantage is the

(Continued on page 962; Technical Editor's comments, page 948)

LEADING DATA: A COMPARISON

	Boeing 727	D.H.121 Mk 1
Powerplant	3 P & W JT8D-1 turbo-fans of 14,000lb	3 Rolls-Royce RB.163 Spey bypass turbojets of 10,100lb
Dimensions:		
Span	108ft	89ft 10in
Length	134ft 1in	114ft 9in
Height	33ft 9in	27ft
Wing area	NA	1,358 sq ft
Sweepback	32°	35°
Max internal cabin width† ...	11ft 7in	11ft 3½in
Max internal cabin height ...	7ft 6in	6ft 8in
Internal cabin length ...	NA	66ft 10½in max
Cargo hold capacity (two holds each)	800 cu ft	620 cu ft
Weights:		
Max take-off	142,000lb*	112,000lb*
Max landing weight ...	131,000lb	100,000lb
Zero fuel weight	NA	85,500lb
Capacity payload	24,000lb	22,370lb
Fuel capacity:	5,829 Imp gal (7,000 US gal)	4,840 Imp gal (5,813 US gal)
Performance:		
Take-off field length (max take-off weight)	5,000ft	6,000ft
Seating accommodation:		
Max economy seating, six abreast	114	100

* 105,000lb without centre section tankage. † Upholstered. NA, not available.

Missiles and Spaceflight

A THIRD FORCE IN SPACE?

THE first step was taken at a meeting in Geneva on December 1 to bring into being a West European organization for space research entirely independent of the United States. This was the signing by representatives of eleven nations of an agreement to set up a Preparatory Commission within two or three months to work out the details of the final organization, which is expected to be formed in about a year's time.

Parties to this agreement are the United Kingdom, France, the Federal German Republic, Italy, Spain,* Switzerland, Belgium, Holland, Denmark, Norway and Sweden. Six of these countries will have to ratify the agreement and this may take a month or so. The Preparatory Commission, which will meet within one month of ratification by not less than six countries, will comprise two representatives from each of the member countries, one a scientist and one a civil servant. They will be empowered to establish working groups and sub-committees for the various technical questions before them. The agreed budget for this is £62,000, to be contributed in proportion to the national incomes of member countries. This means that Britain pays 25 per cent and France and West Germany roughly 20 per cent each.

This is the fruit of some nine months' informal contacts, initiated by the French at the COSPAR space symposium in Nice last January and continued more recently, and more officially, in Paris and at the Royal Society in London. It brings into view another prospective buyer for Britain's cancelled Blue Streak missile, in its role as the first stage of a satellite launcher. It offers the hope for what might be called a "third force" in space to offset American-Soviet rivalry, and since this will be completely separated from defence effort it should be able to exert an influence for the truly peaceful and scientific exploitation of this new area of endeavour.

The programme before the Preparatory Commission is threefold. Firstly, it must thrash out a suitable structure on which the permanent European space-research organization can be set up, decide what it should be called, and specify where its headquarters and secretariat should be located. In view of the Swiss Government's initiative in inviting this most recent inter-governmental conference to meet in Geneva, it is generally assumed that the Swiss are anxious to add the European space-research organization to the list of international agencies already domiciled in Switzerland, if not actually in Geneva.

Secondly, the Preparatory Commission must formulate a budget for the permanent organization and work out the scale of contributions for the member countries. This may be of the order of half a million pounds at the start, with the countries contributing in the proportion of their national incomes.

Thirdly, there is the detailed planning that is likely to take up the greatest time and effort and for which a number of subsidiary working groups will probably be needed. A detailed programme of research has to be drawn up, and the means necessary to carry this into effect must be considered.

A pilot plan of the organization's scientific and technological aims has already been drawn up by the scientists involved in the initial stages of the European space-research group's deliberations. This was circulated after the London meeting of the group at the beginning of October. This provides for a programme of sounding rockets capable of reaching to 200km, a programme of satellite studies, and a programme of work to be carried out from space probes able to reach as far as the Moon, the planets and the close vicinity of the Sun. The last-mentioned studies include work in space biology.

The research is grouped in three stages. The sounding-rocket programme could go into operation immediately, since the rockets are fully developed and available and the designing of equipment to fly in them is less exacting than for satellite research. The first phase of satellite research is conceived in terms of satellites capable of putting a 200lb payload into orbit. These could be developed within three years of the formation of the organization. The second phase, to come into operation within five years, envisages a satellite payload of 1,000-2,000lb or, alternatively, a rather smaller lunar probe.

The third phase which, it is suggested, could be developed in parallel with the first and second phases of the satellite programme and therefore might be ready in five years from the start of operations, is for space probes, including vehicles able to land scientific equipment on the Moon. The space probes would offer the chance for work in lunar and planetary physics, in astronomy and in space biology. Phase 1 of the satellite programme is the kind of thing that would be possible with the use of a converted Blue Streak as the satellite launcher.

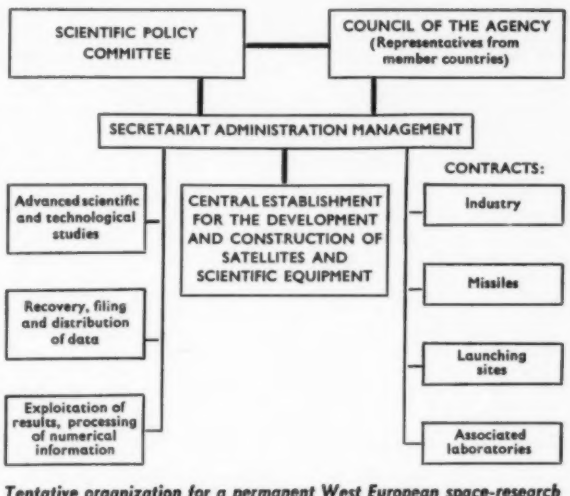
A number of the potential advantages of a European space-research organization are indicated in the pilot plan. Those listed as "indirect benefits" are the most interesting and show the trend of thinking among some of the prime movers of the scheme. They are:—

"(1) that the various advantages accruing from space research will be directly available to Europe,

"(2) that there will be much stimulation of technological research in European industry and of scientific research in universities, and

"(3) that expenditure of implementing the scheme will mostly fall in Europe and will benefit Europe, and particularly in the fields of the technology of materials, the miniaturization and equipment both electrical and mechanical and in tracking and related techniques."

The question on which the Geneva deliberations nearly foundered was whether or not the organization should be directly involved with developing suitable rockets for satellite launching or whether its functions should be limited strictly to space research,


SCIENTIFIC POLICY COMMITTEE
COUNCIL OF THE AGENCY (Representatives from member countries)
SECRETARIAT ADMINISTRATION MANAGEMENT
CONTRACTS:
Advanced scientific and technological studies
CENTRAL ESTABLISHMENT FOR THE DEVELOPMENT AND CONSTRUCTION OF SATELLITES AND SCIENTIFIC EQUIPMENT
Industry
Missiles
Recovery, filing and distribution of data
Launching sites
Exploitation of results, processing of numerical information
Associated laboratories

Tentative organization for a permanent West European space-research agency. This diagram is from the report of the recent London meeting of the European Study Group for Space Research

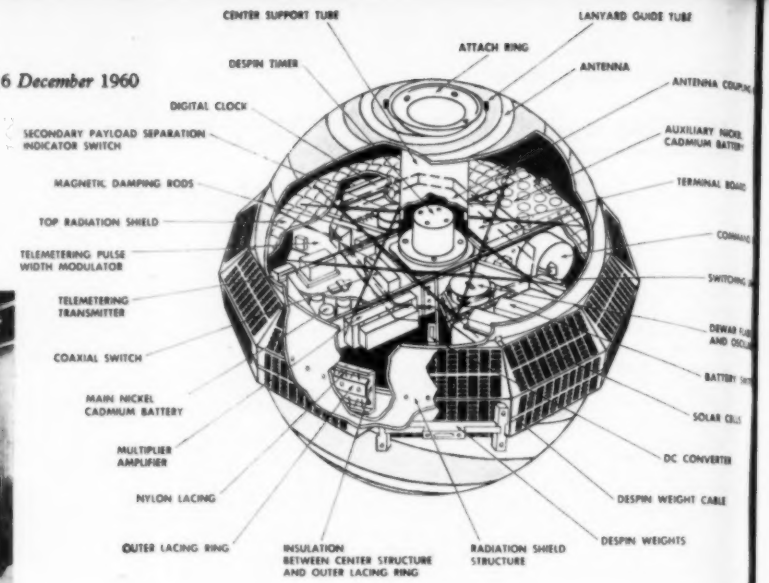
with the matter of how the instruments were to be put into orbit relegated to a separate organization. It was finally decided to block off the awkward question of rocket development from the organization's functions. But space research cannot be carried out without space vehicles, and a resolution was adopted by the conference formulating the responsibilities of the proposed organization in providing its scientists with vehicles for satellite experiments. This included the following clause: "The Preparatory Commission shall take note of the negotiations separately in progress among certain member states of the Conference for the collaborative development of a satellite-launcher [i.e., those in progress with the United Kingdom on the adaptation of Blue Streak]. In the event of an organization being created for this purpose, the Preparatory Commission should consider the closest possible co-operation between this organization and the contemplated European Space Research Organization."

It therefore looks as if Europe will very shortly have two co-operative space organizations, one concerned with developing a rocket to launch European satellites and one concerned with instrumenting such satellites. It might seem that the Geneva conference had neatly sidestepped the main issue, the physical means of carrying out space research; but this impression is perhaps more apparent than real. Because of the phase that the Blue Streak negotiations had reached it was not possible to rely absolutely on such a launcher being available to the European organization, which has therefore been left free to find its space vehicles where it thinks best—including the USA or the Soviet Union if necessary. On the other hand, as was pointed out by Sir Harrie Massey, president of the conference and chairman of the British national space committee, "The object of the exer-

**Spain was initially admitted to the conference preceding the signing of the agreement as an observer, as also were Austria and Jugoslavia (who did not in the event attend). On the morning before the signing of the agreement, Spain was unanimously elected a full member.*

Missiles and Spaceflight . . .

Right, cutaway sketch of Transit 3A navigation satellite, unsuccessfully launched on November 30. Below, inflatable satellites of the type unsuccessfully launched on December 4 (see news item)



cise is for the European space-research programme to be as self-sufficient as possible."

The agreement on space research in Europe may sound tentative and inconclusive. But it is not. Eleven governments are now fully committed to pursuing joint space research from satellites and they can no longer easily draw back. The difficulty of finding a satellite launcher and a launching site at the right price and time and without strings attached remains formidable but, now that the prestige of governments is involved, one may expect that it will be done. The year 1964 may see the first European satellite in orbit with 200lb of instruments aboard.

DISCOVERER 18 IN ORBIT

Discoverer 18, weighing 2,100lb, was successfully placed in orbit from Vandenberg AFB, California, on December 7 by a Thor-Agena B whose first stage was stated to produce 15,000lb more thrust than in previous Discoverer launches. In the recovery capsule were human bone marrow, membrane from a human eyelid, algæ, spores, gamma globulin, albumin, gold foil and various types of film, all of which were to be used in radiation studies leading towards manned spaceflight. The Agena B carried more fuel than earlier Agena As, and could be started and stopped while in orbit.

The attempt to recover the 300lb capsule, originally planned to take place on the day following the launch, was delayed until Saturday, December 10.

SCOUT LAUNCH FAILS

An attempt to launch an inflatable balloon satellite into Earth orbit by means of a four-stage, solid-propellant Scout from Wallops Island, Virginia, was unsuccessful on December 4 because of a second-stage failure in the rocket. The satellite, which would have been 12ft in diameter when inflated, was intended to provide information on air density and drag in an orbit with an altitude of 410-1,275 miles.

The satellite was fabricated from an aluminized Mylar skin, and carried a small radio beacon. Worldwide tracking both optically and by radio was planned, from which computations of atmospheric density could have been made. After the rocket failure on December 4 the launch vehicle and payload fell into the sea 80 miles off the Virginia coast. This was the first attempted US launch of an Earth satellite from anywhere other than Cape Canaveral or the Pacific Missile Range.

SATELLITE COMMUNICATIONS

In the House of Commons on December 1 Mr Mason asked the Postmaster-General "if he is aware of the experiments of the International Telephone and Telegraph Corporation of the United States of America in speeding up global mails by using an electronic mail delivery system which can be immediately coupled to satellite transmission; to what extent Post Office engineers are conducting research into this technique; and what progress Her Majesty's Government are making towards a satellite communications system?"

Mr Bevins stated in reply: "I am aware of the experiments in the United States in the transmission of facsimile copies of letters over telephone circuits and of the claims that this system might eventually be used for transmitting global mails via satellites. My officers are closely studying the possibilities in the field of satellite communications and are keeping in touch with other countries. Technical investigation of the design of communication satellites and of the equipment that would be needed at ground stations is in train. A technical mission has recently returned from a visit to the United States, and I am hopeful that before very long it will be possible to arrange certain experiments in which the United Kingdom will take part."

Boeing rolled out the first production IM-99B Bomarc on December 2. It was shipped to Chanute AFB, Illinois, where it will be used for training USAF and RCAF crews.

Speaking at RAAF Amberley, near Brisbane, on December 1, Air Marshal A. D. Selway, C-in-C FEAF, said that guided weapons would shortly be sent for the defence of Singapore. The missiles will be Bloodhounds or Thunderbirds.

On the night of December 4-5 a Titan ICBM exploded in its underground silo at Vandenberg AFB. One of the first Titans to reach the USAF, it was being fuelled preparatory to a test shot down the Pacific missile range. Damage to the silo (see illustration in *Flight* for November 4, page 709) is estimated at roughly $5m.

The Rocketdyne F-1 engine, with a single-chamber rating of 1,500,000lb, will be ready on schedule early in 1963. Speaking before the American Rocket Society, Mr D. E. Aldrich, F-1 programme manager, gave heartening news of progress and announced that preliminary flight-rating tests would begin late in 1962.

All test objectives were achieved by the second long-range Polaris A-2, launched on a 1,600-mile test from Cape Canaveral on December 5. In Washington last week Vice-Admiral Raborn said that the A-2 should be in submarines early in 1962, and that the later 2,500 n.m. Polaris should be operational early in 1964 (a year earlier than had been expected).

According to a reporter of the London *Daily Herald* an Avro Blue Steel Mk 1 was successfully launched on a free-drop test from a Vulcan at Woomera early this month. The following week a live firing was due to take place. The correspondent reported that up to 100 Blue Steels would be used for various trials next year, flown to Woomera by C-130s of the RAAF chartered by the MoA.

By the time this issue appears the United States is expected to have offered to place Polaris submarines—five, it is said—at the disposal of European members of NATO. The proposal is expected to be accepted, details of control being left for discussion in Oslo next year.

During the first few days of this month Mr C. R. Able, vice-president in charge of defence programmes at Douglas Aircraft, held discussions on Skybolt with the Air Ministry, MoA and Avro. He stated that all stages scheduled for completion in 1960 had been "met or bettered."

Answering questions in the House of Commons on December 5, the Minister of Aviation declined to make a further statement on the Government's plans for space research, but stated; "If the decision were made to go ahead with Blue Streak as a satellite launcher it would be available to the European Space Research Organization."

Bakelite Ltd have produced *Spearhead of a Thunderbird*, a 16mm colour sound film running for 18min, which describes the manufacture and testing of the missile's nose radome. Prints may be borrowed without charge from the company's publicity department, 12-18 Grosvenor Gardens, London SW1.

On December 6 a paper entitled *Solid Propellant Rocket Motors* was read before the Astronautics and Guided Flight Section of the RAeS by Drs W. R. Maxwell and G. H. S. Young. It is a valuable all-round survey of propellants, motor design and manufacturing methods, although for obvious reasons the authors were unable to dwell upon the more modern developments, such as the ignition and destruct systems of Polaris or the nozzle system of Minuteman.

Missiles and Spaceflight . . .

AROUND THE MOON

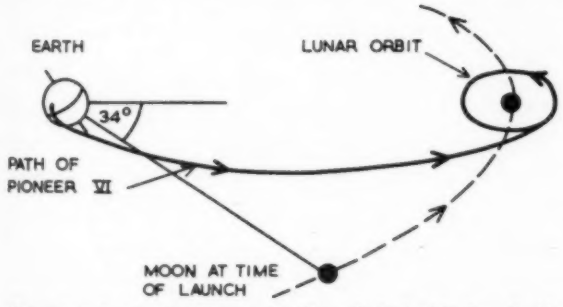
THE launch of Atlas-Able 5B, with a 387lb payload intended for orbit around the Moon, is expected to take place from Cape Canaveral during this month. This will be a "back-up" attempt following the unsuccessful Atlas-Able 5 (Pioneer 6) shot of September 25 last. In this article by D. E. Smith, BSc, FRAS, and A. E. Smith, AIInfSc, GradRAeS, lunar trajectories are discussed. This is followed by a description of the Atlas-Able vehicle and its scientific payload.

THE US National Aeronautics and Space Administration has announced its intention to launch another lunar probe before the end of the year. This will be the sixth American attempt in a little over two years, and follows within a few months of the failure of Pioneer 6. In this article we discuss various aspects of lunar probes and lunar satellites—in particular the types of paths to and around the Moon—and briefly review Russian and American achievements in this field to date.

Paths to the Moon can be of infinite variety, but conveniently they can be divided into two basic types, elliptic and hyperbolic. An elliptical path is followed by a space vehicle which leaves the Earth at less than escape velocity, whilst a vehicle travelling faster than escape velocity follows a hyperbolic path relative to the Earth. Both the ellipse and the hyperbola are, of course, sections of a cone, the ellipse being a closed loop and the hyperbola being open-ended. This fundamental difference means that probes which follow hyperbolic paths away from the Earth do not return (unless their speed is reduced by retro-rockets so that they change to an elliptical orbit), but go into orbit about the Sun.

The minimum launch velocity required to reach the Moon is about 11.1km/sec. A probe launched with this velocity would follow an ellipse which just intersects the Moon's orbit after approximately 116 hours. As the launch velocity is increased the journey time is progressively decreased until, at the escape velocity (11.2km/sec) or cross-over point between elliptical and hyperbolic paths, the journey time comes down to approximately 49 hours. For this to be reduced to the order of, say, 20 hours, the launch velocity must be increased to around 12.2km/sec.

Whichever path is chosen to approach the Moon, retro-rockets must be fitted if a permanent Moon satellite is to be established,

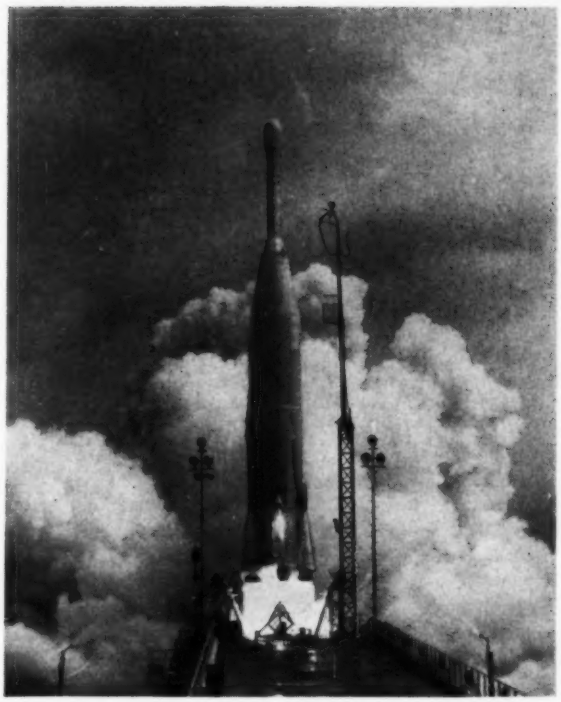


Planned trajectory for Pioneer 6. The principal objective of this experiment is to investigate the environment between Earth and Moon and the control of spacecraft from the Earth

because the gravitational attraction of the Moon increases the probe's speed to a speed in excess of the Moon's escape velocity. The path of the probe is, in fact, hyperbolic relative to the Moon so that, unless the probe actually hits the Moon, it is bound to escape. Nevertheless, the Moon's gravitational pull can deflect the path a considerable amount. The extent of this deflection depends upon the velocity with which the probe enters the Moon's sphere of influence.

Vehicles following hyperbolic paths from the Earth may be deflected so as to pass partly behind the Moon—Lunik 3 did just that—whilst vehicles following elliptic paths from the Earth may be deflected so as actually to circumnavigate the Moon before finally moving away. The use of multi-start retro-rockets makes possible an infinite variety of paths round the Moon and opens up the possibility of returning to Earth. Some of the more interesting paths are shown in the diagram at the foot of column 2.

The exact distance from the Moon at which the retro-rockets are fired depends not only upon the type of approach path to the Moon but also upon the lunar orbit required. The velocity of a prospective lunar satellite must be reduced so that at any given distance from the Moon it lies between two definite limits. The lower limit is set by the velocity at which the satellite will



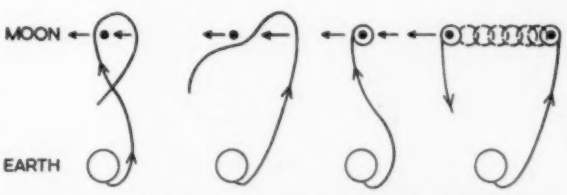
Launch of Atlas-Able 5 from Cape Canaveral on September 25. Intended to place Pioneer 6 in orbit round the Moon, this unsuccessful shot is to be followed by an Atlas-Able 5B attempt this month

have too little speed for it to orbit without striking the Moon; the upper limit is clearly set by the lunar escape velocity at the distance concerned. These minimum and maximum allowable velocities have been calculated (by the authors) for various distances from the Moon and are shown in the diagram on page 942.

In practice, the maximum allowable velocity will have to be rather less than escape velocity in order to achieve orbits of a reasonable size. If we assume that, for practical purposes, the whole of the orbit must lie within the Moon's sphere of influence (a sphere about the Moon of approximately 66,000km radius, in which the Earth's attraction may be ignored), then "realistic" maximum allowable velocities can be calculated. The dotted line in the diagram is in fact a realistic V_{max} line based on this assumption. It shows the velocity at any range which will result in an apogee distance equal to 66,000km. To sum up, if the velocity of the satellite, after firing the retro-rockets, lies between the V_{min} line and the "realistic" V_{max} line, a lunar orbit is assured and the orbit will be completely within the Moon's sphere of influence.

It may be mentioned here that the satellite's final velocity after application of the retro-rockets also determines whether the firing point becomes the ap-lunar or the peri-lunar position of the orbit (the farthest and the nearest positions). At any given distance from the Moon, there is a characteristic circular velocity which lies somewhere between the V_{max} and V_{min} velocities. If the final velocity lies between the circular velocity and the V_{max} velocity, the firing point becomes the peri-lunar position; if, on the other hand, the final velocity lies between the circular velocity and the V_{min} velocity, the firing point becomes the ap-lunar position.

Perhaps the most interesting point brought out by the diagram is that the difference between the "realistic" V_{max} and V_{min} is at a maximum at a distance of about 2,400km (about



Some of the possible trajectories for Earth-launched probes designed to travel to and orbit around the Moon

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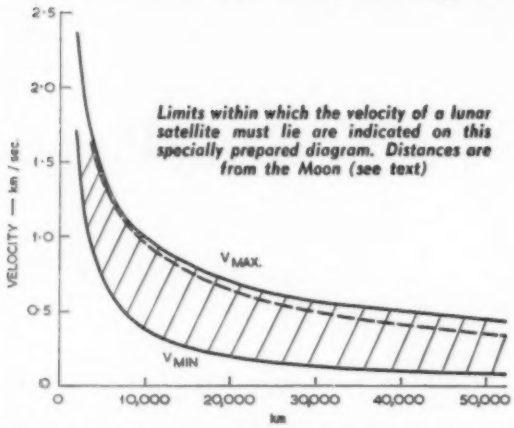

Limits within which the velocity of a lunar satellite must lie are indicated on this specially prepared diagram. Distances are from the Moon (see text)

700km from the surface of the Moon) and amounts to nearly 0.7km/sec. It would seem, therefore, that at this distance there is the greatest possible range of velocities for entry into a lunar orbit.

The velocity of a probe when it first enters the Moon's sphere of influence can vary widely according to the path it has followed from the Earth, but will not be less than approximately 0.6km/sec if the vehicle has been launched from the Earth along an elliptical path (this is the approximate velocity at the apogee position of a probe in an ellipse which just touches the Moon's sphere of influence). As the diagram shows, this is larger than the "realistic" V_{max} velocity even at a distance of 50,000km. As the vehicle moves closer to the Moon its velocity is, of course, gradually increased by the Moon's gravitational pull. If the probe actually strikes the Moon, its velocity will have been increased to about 2.4km/sec which, it will be noted, is only slightly greater than the V_{max} velocity at this point.

A graph of the probe's velocity against distance from the Moon would, in fact, be generally similar in shape to the indicated V_{max} curve. At 50,000km the difference between the probe's velocity and the "realistic" V_{max} is of the order of 0.2km/sec, and becomes progressively less as range decreases until, at the Moon's surface, the difference is less than 0.1km/sec. This indicates that in general the retro-rocket power required to make a vehicle go into orbit about the Moon is least in the case of really close orbits.

Since the Moon has no atmosphere, the lifetime of a lunar satellite which is never more than a few hundred miles from the surface of the Moon may be very great, if not infinite. On the other hand, satellites in relatively large orbits will have their orbits disturbed by the gravitational attractions of the Earth and the Sun, and will have much shorter lifetimes. The Earth's attraction has the effect of pulling the whole orbit towards the Earth so that the ap-lunar distance increases whilst the peri-lunar distance decreases. The rate of movement of the orbit increases as the ap-lunar distance increases until eventually the peri-lunar distance is less than the Moon's radius and the satellite hits the Moon. Although it is possible for a lunar satellite to be drawn away from the Moon and into orbit round the Earth, it is much more likely to come to an end by hitting the Moon.

The time and date of a lunar probe launching have to be chosen with some care to ensure that the probe crosses the Moon's orbit at the same time as the Moon's path intersects the probe's orbit, and also that the Moon is above the horizon of the launching country at that time. This is essential since radio contact with the probe is necessary for commanding the retro-rockets to fire, and also for receiving data from the probe. It is evident that for the point of arrival to be "observed" from the launch site, the time of transit must have an odd factor of about 12 hours—say, 12 hours, 36 hours, 60 hours or thereabouts. In each of these periods, the Earth will have rotated an odd half-day, thus bringing the Moon above the horizon for the observing country.

It is an advantage when launching any space vehicle to give it as large an easterly velocity component as possible. This is simply because the velocity of the Earth as it rotates on its axis is retained by the probe on leaving the Earth's surface. On the equator, this can amount to nearly half a kilometer per second.

The United States has so far launched five lunar probes. On August 17, 1958, a four-stage (unnamed) vehicle carrying a payload of 83lb blew up 77sec after take-off from Cape Canaveral, due to first-stage engine failure. A similar vehicle (Pioneer 1) was successfully launched on October 11, 1958, but only succeeded in travelling about a third of the way to the Moon before returning to Earth. It re-entered the atmosphere over the South Pacific Ocean just over 43 hours after launch. Pioneer 2, the third attempt, was launched on November 8, 1958, but the third stage failed to ignite.

In the fourth attempt on November 26, 1959, a plastic shroud covering the probe fell off 45sec after launch and the payload was torn away. Pioneer 6, the fifth and most recent attempt (September 25 this year) was unsuccessful because of a partial failure of the second-stage engine.

In addition to these lunar probes, the National Aeronautics and Space Administration programmed certain space probes to pass close to the Moon before going into orbit round the Sun. Pioneer 3, launched on December 6, 1958, succeeded in travelling only 63,580 miles from the Earth, and so did not reach the vicinity of the Moon. Pioneer 4, however, launched on March 3, 1959, passed within 37,300 miles of the Moon on the following day and yielded excellent radiation data. Subsequently it went into an orbit round the Sun with a period of 407 days.

The Soviet Union does not release details of its failures, but three Russian lunar probes have been launched successfully to date. Lunik 1, launched on January 2, 1959, went into orbit round the Sun after passing within 5,000 miles of the Moon. Lunik 2 was launched on September 12, 1959, and, 35 hours after launch, the 858lb payload became the first man-made object to hit the Moon. Mr Krushchev, who had just arrived in the United States, called the timing "a simple but pleasant coincidence."

Nevertheless, on the second anniversary of Sputnik 1 (October 4, 1959) the Russians launched their third lunar probe, Lunik 3. This passed within 4,373 miles of the Moon's surface on October 6, and took high-precision photographs of the far side of the Moon which were relayed to Earth between October 11 and 18. Unlike Lunik 2, Lunik 3 remained an Earth satellite in a highly eccentric orbit with a period of about fifteen days. According to Russian reports, it entered the Earth's atmosphere in March this year and was burnt up.

Pioneer 6 type payload, 39in in diameter and 387lb in weight, incorporates 50 four-bladed fans on surface for temperature control; 8,800 silicon cells on four paddles to convert the Sun's heat energy into electricity; and retro-rocket (top of payload) to supply reverse thrust when probe approaches Moon's gravitational field region

Atlas-Able Details

The following description of the launch vehicle, payload and flight sequence applies to Atlas-Able 5. Plans for the launch of Atlas-Able 5B are expected to be identical.

The Atlas-Able probe experiment is conducted by the National Aeronautics and Space Administration, with technical project assistance by the Air Force Ballistic Missile Division. Under subcontract, Space Technology Laboratories Inc has provided overall system integration and spacecraft packaging, subject to the requirements of NASA's Goddard Space Flight Center.

The first stage of the launching vehicle is an Air Force Atlas D intercontinental ballistic missile modified to receive additional stages. It weighs over 255,000lb and provides a thrust of approximately 360,000lb. The Atlas provides booster propulsion for approximately 4½min. [Continued on page 943

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The Atlas has three gimballed engines. The outer two are jettisoned about 2½min after launch, while the sustainer engine provides propulsion for a further two minutes. The Atlas then separates from the remaining stages and falls back into the Earth's atmosphere. About three minutes after lift-off, a glass-fibre nose fairing which covers the third stage and payload flight through the atmosphere is parted lengthwise through the use of explosive bolts. The halves fall away.

The liquid-propellant second stage is similar to those used in the Thor-Able combinations used to place Explorer 6 in an Earth orbit and Pioneer 5 in solar orbit. This stage was adapted from earlier Able rocket vehicles and modified to fit on the first-stage Atlas. Its weight is some 5,000lb and it develops approximately 7,500lb of thrust.

The second stage supplies powered flight for almost two minutes. At second-stage burnout, ten small spin rockets (five positioned on opposite sides of the second stage) are fired, rotating the second, third and payload stages at about 170 r.p.m. The spin stabilizes the trajectory of the third stage and spacecraft. After the spin rockets fire, second/third stage separation occurs. A few seconds after burnout, the second stage drops away.

Adapted from earlier Able and Vanguard rocket configurations, the third-stage solid-propellant rocket burns for about 40sec, weighs over 500lb and develops approximately 3,000lb thrust. Third-stage separation occurs 15sec after engine burnout.

Achieving a lunar orbit will depend largely on the new hydrazine engine in the spacecraft itself. This has two small thrust chambers, at the base and top of the payload respectively, and these chambers are linked by fuel lines to a central hydrazine propellant tank which is 26in in diameter.

The vernier thrust chamber at the base of the payload will be used to increase the velocity of the probe. Four fuel lines run from the vernier chamber to the hydrazine tank. The fuel lines contain valves which let through a desired amount of propellant. Each fuel line—or, more precisely, each valve unit—can be used only once, so that a maximum of four velocity increments can be made.

The injection thrust chamber at the top of the payload is designed to supply reverse thrust when the payload approaches the Moon's gravitational field—about 5,000 miles from the Moon. The reverse thrust chamber has two fuel lines so that only two reverse commands can be initiated. Each chamber can deliver 20lb of thrust. The central tank carries sufficient fuel for a total burning time of 1,700sec.

Velocity Control

Plans call for at least one velocity-increment command within a few minutes following launch, and a reverse-thrust command when the probe nears the Moon. Velocity control, as indicated in the earlier discussion on trajectories, is of prime importance.

Spontaneous ignition takes place in the payload thrust chambers when the hydrazine flows across a catalyst bed of aluminium oxide near the throat of the rocket nozzles. Two small tanks of nitrogen maintain pressure on the hydrazine and force the fuel through the lines when the valves are opened.

With a maximum velocity of over 23,000 m.p.h. (10.28km/sec), the payload would reach the vicinity of the Moon in about 62hr. When it reached a point about 5,000 miles (8,050km) from the Moon, the probe would be travelling at roughly 2,700 m.p.h. (1.2km/sec). To achieve the desired orbit, this must be reduced to about 1,350 m.p.h. (0.6km/sec).

If the mission is successful, the probe should enter orbit around the Moon with a period of about 10hr, an apolune (farthest distance from the Moon) of approximately 3.000 miles (4.830km) and a perilune (closest distance) of 1,500 miles (2,415km).

The mission goal is an extremely difficult one. It has been computed that a variation in booster performance of plus or minus one foot per second causes an error in the vicinity of the Moon as great as 110 miles.

Guidance is as important to the success of the mission as is rocket power. For the first few hundred miles of the flight, guidance units in the first and second stages of the Atlas-Able will steer the vehicle. Programmed autopilots will take care of routine flight corrections. But additional commands can be radioed to the guidance packages in the stages to take care of more-difficult course corrections.

The spacecraft is instrumented to get basic measurements of the cislunar environment, such as radiation readings, indication of any lunar magnetic field, the action of gaseous "clouds" of plasma floating through space, micrometeorite activity and solar-flare effects.

Visible on the aluminium surface of the spheroid in the photograph on page 942 are some of the 50 four-bladed fans, covering circle-segments coloured alternately blue and white, which are used in the temperature-control system of the spacecraft. While

Ground test of nose-fairing separation, using dummy spacecraft and dummy third-stage rocket, in preparation for Atlas-Able 5 shot on September 25. Premature release of this fairing caused failure of November 26, 1959, launch

the external temperature at the tips of the solar-cell paddles may vary from +200° to −200°F, the internal temperature should be maintained at about 70°F.

The temperature-control system is based on the heat-absorbing and heat-reflecting qualities of light and dark surfaces. On the inside skin of the spacecraft, immediately beneath the circular areas covered by the fans, are wire coils which expand when heated and contract when cooled. The dark-coloured segments will absorb sunlight and heat the satellite. As the segment is warmed, the inner coil expands and rotates the fan, which moves to expose less of the blue and more of the white area, and vice versa.

The probe's four "paddles" carry a total of 8,800 silicon cells which convert heat energy into electricity. The paddles measure 24in square and are supported by a spring-mounted aluminium arm. From tip to tip, the span is 9ft. During launch, the paddles are folded down in a square about the base of the sphere, under a 10ft plastic nose fairing which shrouds the third stage and payload. This fairing parts and falls away before the second-stage rocket ignition (see photograph above). After second-stage burnout, the paddle springs are released, forcing the paddles upward and outward until they lock in place.

On each paddle there are 22 modules of solar cells. A module consists of 100 cells and is capable of producing about 1.3 watts of electricity under direct sunlight. Each cell is shielded by a filter which lets in light and reflects harmful ultra-violet rays. The cells are lined up in series and feed into a package of nickel cadmium batteries which power all of the probe's electronic equipment.

Among the scientific instruments carried are (1) high-energy radiation counter developed by Chicago University; (2) ionization chamber and Geiger-Mueller tube to measure total radiation flux, by University of Minnesota; (3) low-energy radiation counter by STL; (4) two STL magnetometers; (5) STL gun scanner; (6) plasma probe developed at NASA's Ames Research Center; (7) scintillation spectrometer (Goddard Space Flight Center and STL) to measure energy spectrum of protons in interplanetary space and study possible trapped radiation about the Moon.

Major contractors for the entire system include:—

First stage: Rocketdyne (propulsion); Convair-Astronautics (airframe, control, electrical and instrumentation; also assembly, integration, checkout and launch).

Second stage: Aerojet-General (propulsion); STL (control, electrical, instrumentation, engine shut-off, spin rockets; also assembly, integration and checkout).

Third stage: Allegany Ballistics Laboratory (propulsion); STL (structure and electrical; also assembly, integration and checkout).

Spacecraft: STL (includes electronics, transmitters, receivers and propulsion).

Launch crew: Aerojet-General, Convair-Astronautics, Rocketdyne and STL.

VTOL Project Work at Belfast

A Short VTOL design with tilting engines on the wing pylons and jet deflection for the two rear propulsive engines

VTOL by jet lift is now clearly a technical possibility, but there remain a variety of opinions on its application to operational aircraft. For six years Shorts have been investigating all sorts of applications, from light strike aircraft with six engines to supersonic civil aircraft with up to 60 or more engines.

Attention was directed first at low level strike/fighter aircraft, mainly because it was felt that there was a need for such aircraft with VTOL capability; moreover, it is possible to design them without undue penalty in performance. It would be a fair generalization to say that low-level aircraft need a good deal less wing area for their flight role than they do for take-off and landing. If we add lifting engines we can, therefore, subtract wing area and hence structure weight, drag and fuel. The resulting aircraft would be satisfactory at low level because it would respond less to gusts and turbulence, usually worst near the ground.

Specially written for "Flight" by

DAVID KEITH-LUCAS,

BA, MIMechE, FRAeS,

Technical Director,

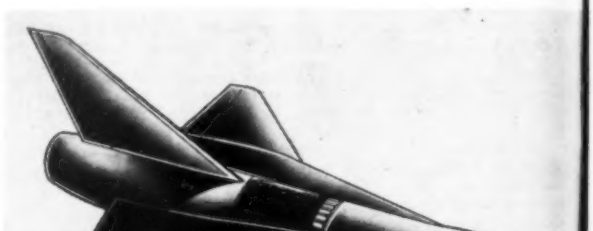
Short Brothers & Harland Ltd

Strike aircraft for the Navy have also been investigated and it was realized that they differed hardly at all from their land-based counterparts. Jet lift takes the magic out of deck landing and makes it possible for an aircraft to operate both from a ship and from land. The obvious advantages of VTOL in the Navy are that it makes nearly all ships into potential aircraft carriers and that the aircraft can be flown off or taken on whether the ship is steaming into wind or down-wind, or is at anchor.

In the early days the projects were all based on the Rolls-Royce RB.108 engines of the kind fitted in the SC.1. Performance, in terms of range and payload, was always marginal and a great deal of work went into devising methods of augmenting the lift. Among the more obvious ways were to provide means of tilting or swivelling the propulsion engines or of deflecting their jet efflux. The design shown in the first illustration has tilting engines on the wing pylons and jet deflection for the two rear propulsive engines.

An alternative proposal was to use a ramp to tilt the whole aircraft so that it took off in a nose-up attitude, thereby getting a component of thrust from the propulsive engines to assist the lift.

More ambitious plans included composite aircraft in which the lifting engines were all in the lower component (this scheme owed much to the Short-Mayo composite of 1936). The upper component, which was the fighting vehicle, had neither lifting engines nor undercarriage and, therefore, had first-rate performance. The big problem was, of course, not the take-off but the landing, as the two components had to mate again in the air. They were therefore designed to have the same response to gusts, and the broad plan was that the top component of jockey aircraft should fly straight and level at an altitude selected for good visibility and the lower component should approach it from behind and below, the actual engagement being made by a hook placed where the pilot of the lower component could see it right in front of his cockpit. The hook was then winched down and the two aircraft drawn together. It was argued that the operation was no more difficult than flight refuelling and that compared to a runway landing there were two alleviating factors—firstly that the height could be chosen for best visibility and secondly that the aircraft and "runway" would respond equally to gusts. Perhaps a comparison with ship-borne landings would have made the case more clearly.



The conception illustrated below uses a ramp to enable the whole aircraft to take off in a nose-up attitude. (Right) This design for a military strike aircraft is derived directly from the SC.1 and also foreshadows the Griffith narrow delta

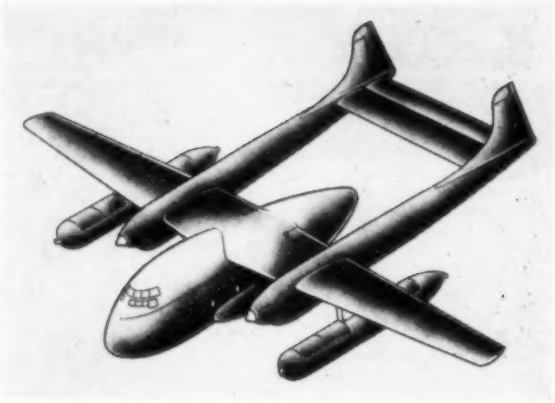
More recent designs have been based on lifting engines giving a greater thrust for their weight. It was then found that the complications of engine tilt, jetpipe deflection or composite aircraft were no longer merited and that the lifting system reverted to something very much like the SC.1. This is fortunate, because it then follows that the military strike aircraft is not only derived directly from the SC.1 but leads equally directly towards the Griffith conception of a supersonic civil aircraft. There are problems of air intakes and of control—especially with an engine cut, which make engine-tilt a lot less attractive than it first appears—and it would have been a pity to spend a lot of effort in overcoming these problems if they arose only on interim designs.

Attention has also been focussed on transport aircraft, partly with a view to providing support for the VTOL strike aircraft. One interesting proposal was an adaptation of the conventional tactical freighter—in this case the Short PD.16. Removable pods or "canoes" were mounted under each wing, approximately at

the centre of lift. Each pod contained eighteen RB.108 engines, twelve of which were forward of the wing and six aft. The intermediate space under the wing contained fuel tanks and equipment. The hovering control system was incorporated in the pods so that when they were removed there was very little VTOL equipment to be carried in the aircraft.

The merit of the idea lay in avoiding the need to develop a completely new aircraft and in the fact that the penalty of VTOL need be carried only on those occasions when it was needed. The performance with RB.108 engines was disappointing and hardly justified the development of the idea, but with later engines it becomes an interesting proposition. Better performance could be achieved with a transport designed for VTOL from the beginning and such an aircraft might have applications in the civil market also.

Throughout their investigations Shorts have looked forward to the VTOL civil aircraft—possibly the Griffith supersonic delta—as their ultimate goal. There is, however, a need for military aircraft which can operate without runways and Shorts feel that this need should be fulfilled first. There will then be a chance to make VTOL more reliable and economical before it enters the civil field.



One adaptation of the Short PD.16 tactical freighter was a VTOL version (upper right) with removable lift - engine pods. (Right) model of VTOL supersonic airliner, based on the Griffith concept

AIR AGRICULTURE BOOMS IN AUSTRALIA

By Stanley Brogden

THE 4,260,000 acres of land treated by the aerial agriculture industry in Australia during 1960 compares with 3,200,000 acres in 1959, 2,400,000 in 1958, and 1,800,000 in 1957. The boom has mainly hit the State of New South Wales, where by 1960 the total tonnage of superphosphate dropped by air will reach 188,000 tons. The NSW boom was so sudden—operators were having a thin time two years ago—that this year the companies could not expand their fleets and personnel fast enough to cope with the work offering. The situation will be the same in NSW in 1961. The surge of work was due to the succession of four good seasons in the State and high wool prices, a combination which has poured money into the pockets of the farmers and graziers.

So many "station properties"—i.e., ranches—now have airstrips that the aerial agricultural industry uses more than 2,000 registered strips in NSW—though many of them, of course, are not actually on the stations. The industry is keen to see still more built, for though it still regards a woolshed as a necessity (a big station may have £15,000 worth of wool in one though it is used only a few days a year), the strips may cost only a fiver in flat country. Owners hope that the time will soon come when a man who is looking over a property to buy it will ask first about the strip and not about the woolshed. For there is no question now that the industry is creating new wealth which would have seemed fantastic twenty years ago.

Aerial agriculture in this country began with Basil Brown, whose Airfarm Associates Pty Ltd, of Tamworth, NSW, is one of the few large organizations in the industry. He now operates four Tiger Moths, a Cessna 180, two Fletcher FU-24s and three Ceres (a remake of the CAC Wirraway); a Lancashire Prospector is soon to be delivered. A New Zealander by birth, he flew with the RAAF and Ansett Airways before helping to found East-West Airways after the war. In 1947 the first linseed crops in the Narrabri district of far north NSW were caterpillar-infested—the heliothis was the criminal. So Mr Brown had them dusted with DDT from a Tiger Moth, 200 acres being treated that July. In 1948 linseed crops started a regular DDT dusting treatment, while East-West also made the first trials of aerial spreading of superphosphate. In 1949 super-spreading began on a commercial scale at Walcha, NSW. As East-West did not want to expand into the new industry, Mr Brown left to found his own organization. Today he is president of the Australian Aerial Agriculture Association and still operates the original crop-dusting aircraft, VH-BUM, a Tiger Moth whose only original part is the registration.

The Association was founded in late 1958 at the direct behest of the then Minister for Primary Industry, Mr MacMahon, who had been appalled by the loose structure of the industry's units which were then appealing to the Federal Government for financial aid. The business had a lot of characters who raised enough money for a Tiger Moth, showed a good profit until it was damaged or became unserviceable and then yelled for help. The years weeded most of these people out, but the accident rate was very bad. It remained so bad that even this year the crash situation in Western Australia became a scandal, secured too much publicity, attracted direct Ministerial (Civil Aviation) criticism, and ended in a conference between operators and the Director-General of Civil Aviation, Mr D. G. Anderson. He told them that unless Tiger Moth accidents were reduced he would consider setting a date for the compulsory withdrawal of the type. Except for one cut forehead, these accidents were without human damage; but one enthusiast had contrived to hit power wires twice (with different Tigers) in three days.

The Tiger is now a fading asset, though still a good spray type. The industry's prosperity has brought in a number of Ceres, Fletchers, Prospectors, Cessna 180s, Cropmasters, Beavers, and now Piper Pawnees. Mr Guy Robertson, a pioneer aerial agriculture operator from Hamilton, New Zealand, was in Sydney in November with a scheme to assemble Fletchers from imported parts and sell them in Australia. Piper has begun a campaign for the Pawnee.

With £25,000 being paid for such an aircraft as the Beaver and £15,000 for the Ceres, it is obvious the industry has progressed. There is a developing agricultural-aircraft market, to which Britain has little to offer apart from the Prospector. The Beaver is the best money-spinner of the lot, given high utilization. This latter has been made possible in NSW largely by a Group Plan. Australian Fertilisers, a subsidiary of Consolidated Zinc, is one of the superphosphate producers, who obviously want to see the industry develop. Less than two years ago they got the NSW operators together and told them that, if they would join the suggested group plan, the company would go out and get business from the primary producers and guarantee work to the operator. This year 90 per cent of the superphosphate dropped in NSW was under the plan. Thanks to this scheme, Aerial Agriculture Pty Ltd has within the last few weeks been reformed as a £250,000 capital company, in which the Consolidated Zinc subsidiaries own 49 per cent and a Sydney tycoon 51 per cent.

In 1961 this firm will operate a fleet of 11 Beavers, and it has invested £60,000 in trucks alone for the filling of these aircraft between flights. This year it has recorded 1,600 hours' utilization per aircraft among its four Beavers. This is the world's highest Beaver utilization, I understand—and can well believe. Utilization is essential; and the system of taking the actual sales effort away from the operator promises nothing but good for the future.

Victoria does not possess an operator of this size, but it has one whose fleet largely comprises Avro Cadets, and he (Mr C. Le

Aerial Agriculture Booms in Australia . . .

Couteur, Aerial Missions Pty Ltd, Moorabbin) only wishes he could buy more. He is, incidentally, the honorary secretary of the Association.

The Victorians, however, did have another scheme. In December 1959 they were called together by the State Lands Department, whose officers had been gingered up by their Minister, a pastoralist who had been to New Zealand and converted to aircraft-employment in agriculture. The Department's officers talked the operators into dividing the State into 11 zones, one per firm, for rabbit baiting. Though the Western Australians use poisoned oats, the Victorians use cut carrots. They drop two successive lots of "free" or edible cut carrots and then drop the "mickey finn." If they dropped the latter first, the bunnies would refuse to eat, but by the time the 1080 poison has been used on the third lot the rabbits are carrot-passionate. Seriously, the Department can now give a written guarantee that any property adequately carrotted will see 95 per cent of all its bunnies dead within days. The Western Australian oats kill 75 per cent at best. The carrot business actually fills in time between the spraying and super-ing seasons, thus giving the Victorian operator a full year. They are scared that the rabbits will not breed quickly enough, though the 5 per cent remaining definitely accept the challenge. The drop, by the way, is 5lb per acre for the first free feed, 6lb for the second, and 7lb for the clincher. Carrot growers charge £12-£15 a ton according to season. The costs are modest: a Tiger Moth doing 400 acres per hour (including carrots cut and loaded), £60; carrots and freight, £45 10s; poison, £5 12s. Total, £111 2s for 400 acres—and that is 5s 6d per acre.

Now that the business is becoming more settled, with price wars and fly-by-night operators vanishing at last, the industry has faced up to organizing itself. The third annual symposium was held in November in Wagga Wagga, a city which 80 years ago produced a celebrated butcher.

Some 80 operators and pilots arrived with 30 aircraft and other equipment for two intensive days of lectures and meetings and a day's flying demonstrations. Lectures included such subjects as *Metal Fatigue*, *Economic Aspects of Aerial Agriculture* (by an economist), *Meteorology*, *Development of Chemicals*, *Bulk Superphosphate Depots*, *Solid Fertilisers*, *Crash Protection*, and so on.

The vital part was the acceptance by the delegates of a plan to form a school to train pilots not only in the specialist form of operations, but also in the scientific aspect. So many stock have been killed by sprays of a toxic nature going astray, and so much danger has been caused to human life, that the State and Federal Governments have intervened to demand the training of pilots and operators in the scientific background to the industry. Hawkesbury College, near Sydney, has offered to accommodate the school and provide lecturers on the science subjects. The Department of Civil Aviation's officers told the conference quite straightly that it must accept a decision by DCA for the rating of pilots and the licensing of operators. The conference agreed and the draft Order is now being discussed between the Association and DCA.

The delegates at once realized that acceptance of the ultimatum meant a rise in status, proper policing of the industry, and an immediate guarantee to the primary producer that properly trained operators and pilots would alone be used for aerial agriculture. Pilots with commercial licences will be accepted for courses in agricultural flying and will be licensed as student applicators. To become full applicators (the official term) they will have to have 500 hours' minimum flying, of which 200 must be in the industry. Operators will have more stringent controls. All pilots and operators now in industry must pass the tests when they are agreed upon next year, and thereafter there will be annual tests for everybody.

HUNTING SOUTH AFRICAN CHANGES

ORGANIZATIONAL changes in the four Hunting Group companies in South Africa have been announced, the main ones concerning the Aircraft Operating Co (Aerial Surveys) Ltd. Mr W. D. Corse, who has completed nearly 40 years' service in the field of aerial survey, is retiring as managing director from December 31 but will remain a member of the board; he is being succeeded in the managing directorship by Mr E. J. D. Pritchard, previously secretary and then commercial director, from January 1. On the same date Mr G. T. Gibbs, the present general manager and alternate director, becomes a full director; he will continue as general manager. Mr R. F. Ashdown, company secretary and alternate director, is in addition to assume the post of commercial manager; and Mr F. P. Roos, previously production manager and alternate director, has been appointed technical representative and will be responsible for promoting aerial survey on behalf of the company.

In Field Aircraft Services Africa Ltd, Mr E. J. D. Pritchard has been appointed managing director from January 1; and from the same date Mr S. H. Evans, the present general manager and alternate director, will become a full director. He will continue as general manager. Hunting Surveys (Rhodesia) (Pvt) Ltd are expanding their activities and the company has already acquired a Wild A5 photogrammetric plotting instrument. Mr P. H. O'Brien has been appointed to the board as resident director and Mr J. Scott has been made manager. Changes announced by the fourth company, Field Aircraft Services (Rhodesia) (Pvt) Ltd, are that Mr E. J. D. Pritchard, who has held the appointments of chairman and managing director, has relinquished the latter position and is succeeded in that post by Mr J. L. Boon, the present sales director.

BOOKS FOR CHRISTMAS

FROM cars to television, from motor cycles to cooking, from caravanning to photography and from aviation to fish-keeping, books published by Iliffe Books Ltd offer a wide and interesting choice of titles for Christmas gifts. The aviation world has particular relevance to the younger generation, for whom the *Boys' Book of Flight* offers an informative and authoritative account of every aspect of flying, supplemented by splendid illustrations. Written by David Le Roi in co-operation with the staff of *Flight*, and with a foreword by Peter Twiss, this book is 12s 6d net (by post 13s 6d). For older and more specialized aviation enthusiasts, there is *Gas Turbines and Jet Propulsion* by G. Geoffrey Smith, revised by F. C. Sheffield (35s net; by post 36s 9d).

Latest books in the motoring field are *The Autocar Handbook* (12s 6d net; by post 13s 8d); *Car Driving as an Art* (12s 6d net; by post 13s 6d); and, for those with an eye to 1961 summer holidays, *Caravanning and Camping for Motorists* (8s 6d net; by post 9s 2d) and *Go Continental—By Car* (17s 6d net; by post 18s 5d). Television will probably play a large part in all family Christmas celebrations, and two books about it may be useful: *Correcting Television Picture Faults* (4s net; by post 4s 6d); and *Improve Your Television Reception* (5s net; by post 5s 6d). For the man who finds a motor cycle in his Christmas stocking a useful accompanying gift would be *The Motor Cycle Guide for the L-Rider* (2s 6d net; by post 2s 11d) or *Motor Cycles and How to Manage Them* (7s 6d net; by post 8s 6d). Two books dealing with films and photography which are new this year are *Filming with 16mm* (25s net; by post 25s 11d) and *New Photograms 1961* (21s net; by post 22s 9d).

Any good bookseller or newsagent will be able to supply these books; but in case of difficulty readers should write to Iliffe Books Ltd, Dorset House, Stamford Street, London SE1, enclosing the appropriate remittance, which should include the cost of postage.

Diaries always make useful Christmas gifts, and the *Amateur Photographer Diary for 1961* is no exception, containing much useful information on all aspects of photographic work. Prices are 6s 9d (including 1s pt) for the leather-bound diary and 4s 9d (including 9d pt) for the Rexine-covered. Postage is 4d on both. This diary is published by T. J. & J. Smith Ltd, 12 Hanover Square, London W1, in conjunction with *Amateur Photographer*. Other Iliffe diaries published from the same address are: *The Autocar Motorist's Diary*, 6s 9d leather (overseas 5s 9d), 4s 9d rexine (overseas 4s), postage 4d in both cases; *The Motor Cycle Diary*, prices for which are the same as those for *The Autocar* diary; the *Wireless World Diary* (also the same prices); and *Yachting World Diary*, which is 11s in real morocco leather (overseas 9s 6d) and 6s 9d in waterproof leathercloth (overseas 5s 9d), postage on each, 5d.

FORTHCOMING EVENTS

Dec. 17. Institute of the Aeronautical Sciences: Wright Brothers Lecture, Washington, DC.
Dec. 20. RAeS: "Aircraft Shapes and their Aerodynamics at Supersonic Speeds," by Dr D. Küchemann.
Dec. 20. Institute of Transport (West Middlesex Group): "Organization and Methods Work in Air Transport," by P. Garner and D. Hollings.
Dec. 21. Kronfeld Club: Christmas Party.
Dec. 22. RAeS: Fourth Lanchester Memorial Lecture. "British Universities and Aeronautical Research," by Prof A. D. Young.
Jan. 3. RAeS Astronautics and Guided Flight Section: "Planning of Missiles Acceptance Trials," by J. F. W. Mercer and A. R. Cawthorne.
Jan. 4. BritIRE (Radar Group): "Automatic Techniques in Civil Airline Communications Systems," by W. E. Brunt.
Jan. 5. RAeS: Young People's Lecture, by R. J. Lees.
Jan. 6-7. RAeS (joint meeting with College of Aeronautics and BIS at Cranfield): Rocket Propulsion Symposium.
Jan. 9. RAeS Historical Group: "Rebuilding and Flying Historic Aeroplanes," by Air Cdre A. H. Wheeler.
Jan. 11. BritIRE (South Wales Section): "The Measurement of Ionizing Radiation," by R. G. Wood.
Jan. 11. BritIRE (West Midlands Section): "An Equipment for Automatically Processing Time-multiplexed Telemetry Data," by N. Purnell and T. T. Walters.

The black boxes and control panels of the Republic F-105 Thunderchief which are described below

FLIGHT SYSTEM SURVEY

Radar for Kastrup

INSTALLATION of a Marconi S264A surveillance radar at Kastrup, the international airport for Copenhagen, should be completed this month. The equipment includes main and standby transmitter/receivers with a single aerial, together with duplicated distribution and MTI racks and five fixed-coil display units with intertrace marking. The contract exceeds £89,000.

Hearing Through the Skin

AT an ARDC symposium in Boston it was proposed that pilots might be able to receive information at voice frequencies through a small metal plate placed next to the skin on the chest. Voice communication would be possible in high ambient noise or when the pilot's other senses were fully occupied.

Thunderchief Electronics

GROUPED in the accompanying picture are almost fifty of the black boxes and control panels which form the mission and traffic control electronics of the Republic F-105 Thunderchief. The Republic man is holding what appears to be the sensing portion of a stick-top autopilot controller next to an aiming sight with an exceptionally large, half-silvered screen. The automatic flight control system panel, at left centre, includes switches for i.a.s., Mach number and other locks and for a stability augmentation mode. Controllers are also visible for two communications radios, possibly UHF and HF; and there is an elaborate IFF controller. At right centre is a navigation computer with latitude and longitude presentation, first and second leg setting controls, selector for gyro, magnetic and emergency settings and a memory control which implies the use of Doppler. This aid is certainly carried in the aircraft. There are no less than four compass or bearing indicators and a Bendix omni-magnetic cross-pointer. Various forms of flat and recessed aerial containers and an aerial coupler are visible, together with two gyro packs, one of them apparently a vertical gyro and the other rate or directional. A frame aerial behind the man's left shoulder fits in a skin cut-out and contains cable laid approximately in the form of a Maltese cross. There is only one pressurized container and many of the black boxes seem to have their own filtered cooling intakes. The actual search and bombing radar is absent.

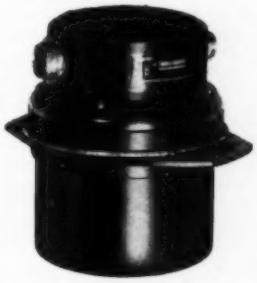
Of considerable interest is the group of plain metal boxes mounted above and below a shelf on a stand at top right. This is the Collins integrated electronic system, tailored specially for the F-105 to fit into a bay beneath the cockpit so that all cooling is passed into the shelf and then to individual boxes. It is called AN/ASQ-37 and includes UHF, Tacan, ADF and intercom with their power supplies, each made up from modules of standard shape and divided into five major packages. The units suspended beneath the shelf have sloped fronts to fit the contour of the compartment. In the prototype F-105s, this equipment occupied twice the space. The B+ and bias voltages for communication, intercom and IFF are taken from transistorized power supplies using a d.c. source with an a.c.-derived standby. Another advantage of the single-shelf arrangement is that shock-mounts are provided for the shelf itself and not for individual boxes. Collins also provide integrated systems for the McDonnell F4H-1 and the North American A3J Vigilante, although the US Navy calls the systems Communications-Navigation-Identification units.

Solar Generator for Lighting

THE Centre de Recherches Physico-chimiques of CSF has produced a solar generator which is claimed to be the largest static generator in existence. The unit has just been put into operation at Toulon and was designed with the aid of the Service Technique des Télécommunications de l'Air. Possible future applications include providing current for aeronautical beacon lights installed in remote areas.

Proven Gyro Reliability

SOME creditable reliability figures have been issued by Smiths Aviation Division for the azimuth gyro which forms part of the Smiths Flight System installed since 1957 in BEA Viscount 800s and in BOAC and other operators' Britannias. Comet 4Bs and Vanguards also have the gyro, each installation including two units. During the first 21,500hr of operation in BEA Viscounts, there were only eleven unscheduled gyro changes, not all of them due to defective gyros. By virtue of this performance, the life between overhauls was doubled from 1,500hr to 3,000hr. It has since been raised to 3,200hr and may increase to 3,500hr in the near future. Cunard Eagle recently returned for overhaul a gyro which had run for 3,625hr in a Britannia. Its performance was still within specification and its condition good. Gyros of this type have now also been installed in military aircraft as main or standby units.



The Smiths Flight System azimuth gyro

A service analysis covering 52 azimuth gyros which were removed by BEA during the six months ending in September this year reveals that more than 90 per cent of them achieved their overhaul life within the maintenance scheduling practised by BEA. Between them they totalled 130,000hr and, taking into account unscheduled changes, they achieved an average overhaul life of just over 2,500hr. Eleven gyros completed 3,000hr or more. During the peak summer operating months there were only six unscheduled changes and the worst defect rate per 1,000 aircraft hours was 0.3, the best being 0.1. Because each aircraft carries two of the gyros, the actual unit defect rates per 1,000hr are only half those shown above.

Welding Micro-modules

THE electronics department of Hamilton Standard has been awarded a US Army Signal Corps contract to study electron beam welding of electrical connections on micro-modules. The company holds the technical and manufacturing rights for such a process developed by the Carl Zeiss Foundation in Germany. Soldered terminals are too large when the module substrates are very closely packed and electron beam welding might be applied to produce interconnections at densities of 1,600/sq in. The electron beam can be focused to a spot size of less than 0.01in with depth to width ratios as great as 20 : 1.

ANALYSING THE 727

Some Comments on Boeing's Design . . . **by the Technical Editor**

ON page 938 it is recorded that two of the largest American operators have each bought 40 of Boeing's triple-jet Model 727 airliner. Many areas of its design remain protected by Boeing, and the same is true of the powerplant; but enough is known for a technical commentary from the British viewpoint to be attempted. Throughout the design of the 727 one can see the results of the policy of reaping the maximum reward from the vast service experience gained with the 707.

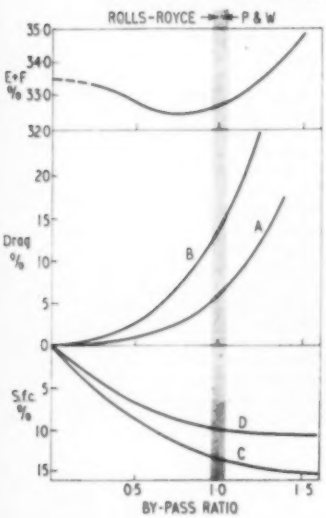
Since it is a rather larger aeroplane than the Trident 1 the 727 needs engines more powerful than the Spey, and although Boeing recently told us that the Rolls-Royce engine spectrum included a unit—which would have been marketed, and possibly manufactured, by Allison—perfectly matched to the 727, Eastern and United, the two operators to whom the company looked for the bedrock on which to base the programme, both wanted Pratt & Whitney. The engine chosen is the JT8D-1, a turbofan derivative of the J52 turbojet. The latter was planned in 1955 for an advanced version of the A4D US Navy attack aircraft; this programme was cancelled and the engine was reinstated in revised form to drive the Hound Dog air-launched strategic missile. It is doubtful if this application is of much value to the JT8D, but a special version of the J52, with tilting tailpipes, has been developed to power the Intruder US Navy attack bomber. It is surprising that Boeing should describe the J52 as being "in wide military service," since it seems to have powered only a single aeroplane (the first Intruder).

But it is increasingly obvious that military flight-time is of little importance in the development of an airline engine. Modern techniques in the Willgoos high-altitude laboratory should be able to simulate airline conditions with complete fidelity, and modern testing techniques are such that, in Britain at least, engineers feel they can develop a reliable engine without flying it at all.

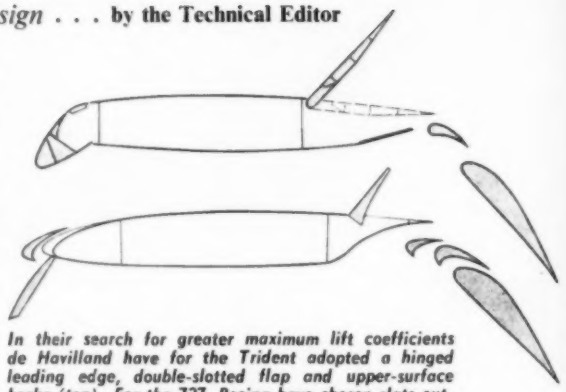
Although the JT8D will look quite unlike the Spey, the engineers at Hartford have paid their counterparts at Derby the compliment of making it thermodynamically virtually identical. Three of the most important factors which determine the by-pass ratio of engines for this market are sketched on this page. The original airline Conway has the low ratio of 0.3, while the JT3D has a ratio of 1.5. Although it would be futile to deny that the two companies have spent a lot of time looking over each other's shoulders, they have made their own calculations and independently concluded that the best value is near unity (indicated by a tinted strip in the illustration).

Pratt & Whitney's first attempt to do a turbofan for this market was the JTF-10, rated at 8,250lb and intended for the defunct DC-9. This engine had a by-pass ratio of about 1.5, and also stemmed from the J52. In view of the fact that the straight turbojet has military ratings of between 7,500 and 8,000lb it seems clear that the new 727 engine is altogether larger, and it may be that no J52 parts are incorporated at all. It is worth noting that in the 727 the fan air is ducted aft, as in a Rolls-Royce engine, to pass through a single reverser and mix with the hot jet in the nozzle. Boeing have done well to fit a reverser on the middle engine.

Switching to aerodynamics, it is probably fair to comment that, while the game of finding the right wing to meet the cruising case is a straightforward slog with tunnel models and computers, the number of variables which can be introduced to meet the landing case makes the final wing design elusive. de Havilland eventually arrived at a wing with an M_{NO} of 0.875



Curves, plotted against by-pass ratio, of engine+fuel weight for a 1,000 n.m. stage (expressed as percentage of aircraft gross weight), increase in total engine drag (A), increase in total pod drag (B), and reduction in s.f.c. allowing for (C) accessories and air bleed and (D) for increasing pod drag also. As indicated, Rolls-Royce and Pratt and Whitney are both approaching a by-pass ratio of unity, one from below and the other from above



In their search for greater maximum lift coefficients de Havilland have for the Trident adopted a hinged leading edge, double-slotted flap and upper-surface brake (top). For the 727, Boeing have chosen slats outboard, leading-edge flaps inboard, triple-slotted flaps and spoilers

above 24,000ft and a best-economy point of M0.87 at 32,000ft—a remarkable speed when it is considered that "maximum economy" means what it says. The Hatfield aerodynamicists probably thought they had gone far enough in adopting leading-edge flaps and double-slotted trailing-edge flaps, but Boeing have tried to go one better. Whether or not they have succeeded depends on such other factors as the first cost of the aircraft and the trouble it will give in service.

As we noted in our October 14 issue, Boeing have aimed at a maximum lift coefficient of 2.5 in order to meet a challenging requirement in the matter of field-length; and it is rumoured in Britain that they have achieved 2.8. The accompanying sketches of wing profiles indicate the degree of complexity necessary to achieve such a figure; and, although Boeing do not mention it, rough calculations suggest that the 727 may well have partially blown flaps. When we visited the company last month the "dash-80" prototype of the 707 family was flying with blown flaps under the wing fillets and sonic blowing around all the "dirty" areas of the main flaps, including jets intended to clean up the airflow over the flap rails. Yet another indication of the importance of the field-length limitation is the fact that the 727's sweep angle is less than that of either the 707 or the Trident.

From the early days of the Comet 1 de Havilland have been wedded to fully powered flying controls, and in the Trident a fully triplexed system is employed—three jacks on each surface—to provide a two-over-one majority rule in the event of failure. Each of three independent hydraulic supplies is served by its own engine, and the D.H./BEA/Smiths team have by specific reliability requirements of ARB been forced to apply extensive multiplication—their solution is triplex throughout—in order to meet automatic-landing safety levels. Such a situation has not yet been faced at Seattle and, as was reported in our issue of November 25 (page 840), Boeing are not trying to do anything comparable with the 727. The flying controls of the new airliner are really manual with hydraulic boost, so that effective manual reversion is possible. It may be recalled that on the 707 series not even hydraulic boost is provided on ailerons and elevators, and Boeing seem to think that fully powered controls are something one should always try to do without.

British designers, on the other hand, took the decision to apply fully powered controls without manual reversion in conjunction with an all-flying tailplane. The addition of a multiplicated automatic landing system to the 727 appears to be extremely difficult, involving as it does the application of genuine multiplication to a fundamentally split-authority control system. The addition of a set of triplicated or triplexed autopilot servos to the manual/boosted controls would raise some interesting statistical problems in reliability calculations.

From the scanty details available it appears that the accessory systems of the 727 depart hardly at all from previous practice, although doubtless one or two surprises are in store (not a word is available on ice protection). For the Trident, DH and Rolls-Royce are confident enough to pressurize the cabin by direct air bleed, as is at present proving quite successful with the Caravelle. Boeing are known to have looked at such systems for many years; but they have yet to succeed in discarding the bleed-air turbo-compressors which pump fresh air to the cabins of 707s and 720s, and the same dual-cycle arrangement will be perpetuated in at least the first 727s. Later, if it can be demonstrated that the inside of the 727 could never become filled with vapour from hot turbine oil, Boeing may adopt a direct bleed system.

Ready for a night sortie in a Javelin FAW.5 at RAF Leeming: Flt Lt A. J. Prosser (left) and Flt Lt Ray Hardy, both No 2 Sqn instructors

All-weather Training by No 228 Operational Conversion Unit

"FLIGHT" PHOTOGRAPHS

Learning at Leeming

A GREAT white swath of cloud covered the Pennines, a thick North Riding blanket from 2,300ft to 7,500ft. Above it, at 12,000ft, we sat in the sunshine. The rear cockpit of our Gloster Javelin T.3 was comfortably warm; with the starboard Bristol Siddeley Sapphire switched off to conserve fuel we were cruising steadily at around 290kt. The long perspex hood and the aircraft's delta wing configuration afforded splendid all-round visibility, except for directly downwards, where the view was impeded by the engine cowlings.

About 1,500ft below and somewhat to our right was a neat formation of seven aircraft: three Javelin FAW.5s in vic, accompanied by two Canberra T.11s and with two Meteor NF.14s filling the outside berths. Behind the formation came another Meteor NF.14, being used as "whipper-in" and photographic aircraft; for No 228 Operational Conversation Unit, which uses these types to train pilots and navigators as two-man crews for all-weather interception duties, was on this occasion sitting for an aerial portrait.

The formation, followed by the NF.14, with our T.3 bringing up the rear, had taken off some ten minutes earlier from RAF Leeming in the Vale of York. This station, commanded by Gp Capt K. P. Smales, has been the headquarters of No 228 OCU since May 1947. During the war years it was used for Bomber Command operations, first by the RAF and then (from mid-1942 onwards) by RCAF squadrons. The first Gloster Javelin course, to train crews for Fighter Command all-weather squadrons, started there in October 1957 (previously, training was done for operations in Meteors). In subsequent years, over 30 courses have passed out at Leeming, going from there to Javelin squadrons.

The mixed formation indicates the two-stream type of training which is given at Leeming. Navigators receive their instruction aboard the T.11 Canberras before linking up with the pilots they are to operate with as crews; and the pilots receive their basic Javelin instruction on the T.3s, before going on to fly the FAW.5s. Until recently, pilots coming for courses at No 228 OCU have been "second tourists": they may, for example, have recently done a tour on Hunter day fighters; or alternatively, in the case of navigators, have been "retreads" who have served on all-weather squadrons but not yet been acquainted with the type of AI which is staple equipment for Javelin squadrons. Also, however, navigators have come to Leeming direct from training schools like Thorney Island and Topcliffe, and next month four are due to come from Cranwell. However, pilots are now coming through Leeming who are about to undertake their first tour in operational aircraft on Javelins. This change in emphasis says much for the thorough standard of training being given at No 228 OCU and also for the acceptable qualities of the Javelin as an operational aircraft.

Gp Capt K. P. Smales, DSO, DFC (at right of front row), and his wing commanders at a night flying briefing. To his right are Wg Cdr V. S. H. Duclos, DFC, OC Flying Wing; Wg Cdr W. E. Thomas, AFC, OC Advanced Wing; Wg Cdr E. W. Deacon, DSO, DFC, AFC, OC Admin Wing; and Wg Cdr J. Harvey, OC Technical Wing

Navigators do a preliminary course of 10 weeks' basic training, then after a week's leave join up with the pilots for a 15 weeks' course. Pilots and navigators are not put together in crews; they "tend to search each other out," and in over two years there has been only one failure in this system of self-selection. Teamwork, based on mutual respect and co-operation, is very important in all-weather fighters.

Leeming has been likened to an aircraft carrier, as a self-contained unit with its aircraft and their supporting aircrew, technical and administrative organizations. There is a total of 54 machines at the station: Canberras (one T.4 and the rest T.11s); Meteors (one T.7, the rest NF.14s); and Javelins (six T.3s and the others FAW.5s). The station is organized not on the usual three-wing basis but with four wings: Flying Wing (Wg Cdr V. S. H. Duclos); Advanced Wing (Wg Cdr W. E. Thomas); Technical Wing (Wg Cdr J. Harvey); and Administrative Wing (Wg Cdr E. W. Deacon). Wg Cdr Duclos is responsible to the station commander for supervising all flying at Leeming and also has responsibility for the supporting services, such as ATC, GCA, GCI, ground training centre and the crash services. (The GCI unit is a unique feature of Leeming equipment, existing to control the practice interceptions which are the ultimate aim of all-weather training. If the station did not have a GCI its aircraft would have to do their PIs elsewhere.) Wg Cdr Thomas is directly responsible to the station commander for crew training of pilots and navigators.

Training is divided between five squadrons. No 1 Sqn (Sqn Ldr A. C. Warren) has all the Canberras and Meteors and is responsible for the basic training of navigators. It can also operate some of its Meteors to tow targets for the Javelins. The other squadrons are all under the Advanced Wing, as follows: No 2 (Sqn Ldr D. Bish), 3 (Sqn Ldr J. A. Gilbert), 4, the handling squadron (Sqn Ldr G. H. Jarvis) and 5 (Sqn Ldr A. M. Durrant). The 15-week course is based on a five-weekly cycle, the pilots coming to Leeming to link up with navigators who have already been through No 1 Sqn for their basic tuition. There follows 2½ weeks of concentrated ground training, which navigators and pilots do collectively. Then the pilots are given dual trips in a T.3 before going solo in an FAW.5. The form of a pilot's first solo in a Javelin shows the intensity and thoroughness of training at Leeming. In a 50min sortie he takes off, climbs to 35,000ft, flies the aircraft straight and level at MO.9, tries the effect of trimming, deceleration and turns, carries out a max rate descent, doing a QGH followed by a GCA from 27,000ft, makes an approach

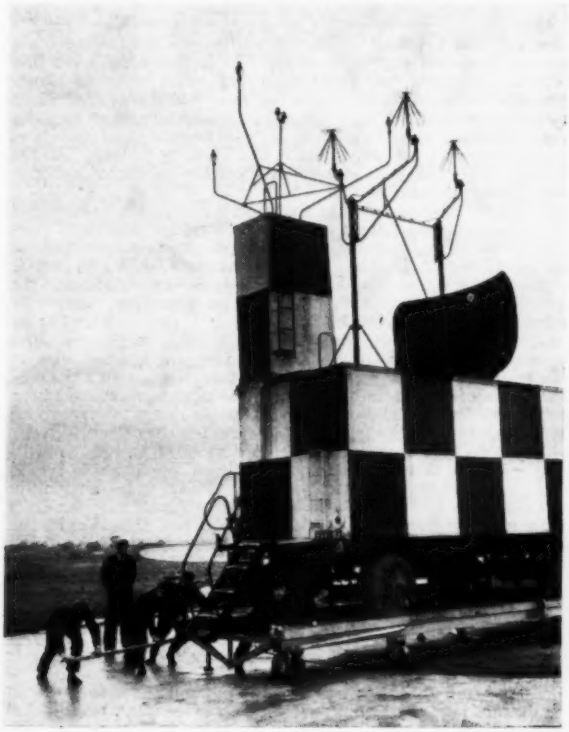
(*Continued on page 952, after double page of Leeming pictures*)

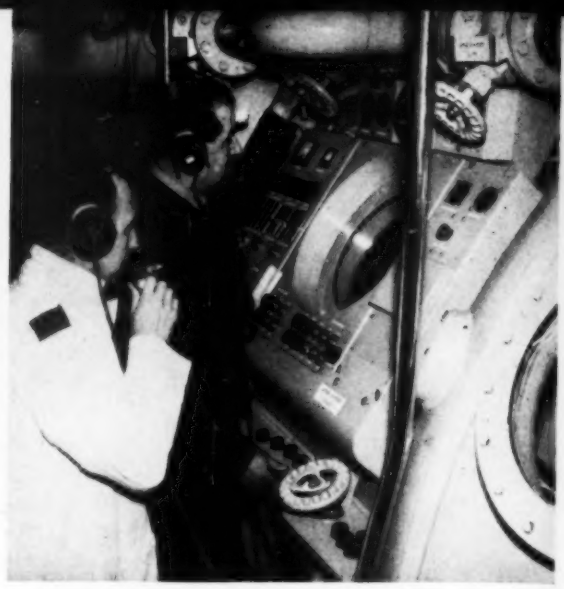
ATC staff in the control tower at Leeming, with Javelins visible outside on the aircraft servicing platform. The SATCO, Sqn Ldr K. W. Holmes, is in the centre; on his left is WO W. A. Kemp and on his right SAC R. A. Butterworth

LEARNING AT LEEMING . . .

"FLIGHT" PHOTOGRAPHS

All-weather fighters in their element: the formation at left (three Javelin FAW.5s with a T.3 in the box position) is led by Wg Cdr W. E. Thomas, who commands the Advanced Flying Wing at No 228 OCU. Below, Leeming's rotatable GCA, a unique installation, being moved round on its turntable. Supervising the operation is one of the controllers, Flt Lt H. H. Wright





Above, Flt Lt L. MacKinnon, DSC, and Flt Lt T. Greenwood, simulator instructors in the ground training centre, about to fly the Redifon-built full flight simulator which is being installed at Leeming. Right, the SMO, Sqn Ldr R. H. Brown, with Sgt C. T. Pitts supervising a decompression chamber test

Learning at Leeming . . .

and roller (overshoot) landing, then an approach without flaps and airbrakes, then an approach with airbrakes and no flaps, and finally a landing. It is quite clear that, from the beginning, No 228 OCU sets out to teach the new pilot everything he ought to know about his aeroplane.

Leeming airfield was built on the usual wartime three-runway pattern but has since been extended, so that the longest runway (34/16) is now 2,500yd in length. About six months ago, arrester barriers were installed at each end of it. As an alternative, in the event of an extreme emergency or for piston-engined aircraft when there is a cross-wind of unacceptable component, runway 04/22 offers a maximum of 1,600yd including some sterile surface. The third runway is now out of use.

During their training period, it is essential that all-weather crews should have confidence in the recovery aids provided at their home base. With CR/DF, UHF and VHF, and a GCA aligned to the main runway, they have the backing at Leeming of a well-equipped air traffic control. The SATCO, Sqn Ldr K. W. Holmes, has been "in the business" for over ten years and it is on his initiative that the GCA equipment has been installed on a turn-table. This means that when landing direction is changed on the main runway the GCA can be in operation again in three minutes, compared with two hours if the equipment had to be driven across the airfield and set up on another site. At Leeming, the two mounted caravans which contain the GCA equipment are simply pushed around by three or four airmen and locked into their new position; the work of the controllers inside continues virtually uninterrupted. Three facilities—search, precision and communication—give them control of an aircraft up to 40 miles away, pictures of its glidepath in both azimuth and elevation, and transmission and reception by both VHF and UHF. (All the Javelins at No 228 OCU are now equipped for UHF; the Canberras and Meteors are still on VHF.)

From the control tower at Leeming it is possible to see most of the airfield apart from a 600-yard section of the main runway, towards its south-east end, view of which is now blanked off by a hangar. In front of the tower is the ASP, its surface blackened by smoke from the Javelins' starter cartridges; and the airfield emergency vehicles are all under immediate contact by radio-telephone. One of the staff pilots from the Advanced Wing is always in the tower when training flying is in progress, and an instructor monitors initial landings from the runway caravan.

This close supervision is a feature of training at No 228 OCU and undoubtedly accounts for the high standards which have been achieved. In two and a half years since Javelins have been operating at the station, there have been no accidents directly attributable to pilot error, a fine record of which the unit is justifiably proud. When a student pilot makes his first solo sorties in a Javelin, his instructor checks starting procedure by plugging-in a long lead on the ASP, listening-in to make sure that the drills are done correctly. Before the student gets into a Javelin, he has been indoctrinated with cockpit procedures at the ground training centre in a mock-up simulating the aircraft's services. At the centre, the fuel, air and hydraulic systems are diagrammatically displayed. These studies are part of the 2½ weeks' concentrated ground training given to all crews before they start flying. If the pilots get into trouble in the air, they not only have the benefit of verbal advice from the control tower (given by the instructor who is duty officer); they also carry with them "flip" cards (flight reference cards) which on one side show normal procedures and on the other the procedures to be used under emergency conditions.

The ground centre also provides training for the student navigators in AI procedures, exercises—of which there are 20 in all—being done on the simulators before they are carried out in the air. An addition to Redifon equipment at the OCU is a full flight simulator, at present still on acceptance trials, which is to come into use early next year. The instructors at the centre are all staff navigators and pilots of the training squadrons, in current flying practice. Tuition is given not only on the standard AI equipment but also on the Mk 22 (American) type of airborne interception radar.

During their 15 weeks' course, the crews under training do about 75hr flying by day and by night. (This figure is approximate, because it may vary from 65 to 85hr, depending on weather conditions and on the aptitude of the individuals concerned and their efficiency as a team.) While the pilot is converting to Javelins, the student navigator is given six trips with an instructor, to be shown what an all-weather pilot requires. The student pilot then flies with a staff navigator, to be given an accurate picture of interception procedures. When the new crew have begun to get their own grasp of the techniques, they are subjected to a "mid-term trailer." This means that a third FAW.5, with a staff crew aboard, trail the Javelin which is acting as "fighter" to study its attacks on the target aircraft and assess both the navigator's capability in interception and the pilot's ability to fly accurately. It seems clear that at No 228 OCU nothing is left to chance in producing crews of the highest calibre for Fighter Command's all-weather squadrons.

Behind the training done at Leeming stands the maintenance efficiency of the Technical Wing, which with 54 aircraft of three different types on its hands has no light servicing task. In particular, the complications of Javelin equipment pose problems which demand specialization. To this end, groundcrew at Leeming tend to concentrate on one type of aircraft rather than switching from one to the other. On the Javelins, 800hr inspections can be anticipated by 10 per cent either way, giving a useful margin of flexibility. The Technical Wing supports both Flying Wings from a common servicing bay.

At the end of the photographic sortie with which this description of No 228 OCU opened, we were over the Northumberland coast, looking down on Lindisfarne with clear air and green countryside below. The T.3 broke away from box formation with the three FAW.5s and as we turned southwards the pilot, Flt Lt Eric Ginger, called Leeming for a course to steer. We were at 13,000ft and the rear cockpit was offered control, an offer readily accepted. Ginger said: "Pull the nose up towards that cloud ahead and put the stick over to the right; you'll see how easily she rolls." Round we went, with no trouble at all; but on a second attempt the student pilot tried to use rudder, as on a lighter aircraft, with disastrous results. We found ourselves in a sort of downward corkscrew, from which the Javelin was quickly rescued, and the roll demonstrated properly. Another attempt by the student, this time with the port engine switched off, showed not only how amenable the aircraft is to this sort of aerobatic but how uncomplicated is its asymmetric performance. On this experience, Javelins give not only a sense of power and solidity but also have considerable agility, qualities needed for all-weather operations. It is not only the fitness of the aircraft as an operational platform, but also the thoroughness of the training, which produce the good results which are continually being achieved by No 228 Operational Conversion Unit at Leeming. The station's motto is "straight and true," and its badge a sword pointing upwards, aptly symbolizing the defensive functions of the all-weather squadrons.

H. W.

Straight and Level

OUR Minister of Aviation, asked in the Commons last week about co-operation with other countries in the development of a supersonic airliner, said: "I do not rule out co-operation with other countries."

Anyone who feels even remotely optimistic about the prospects of aeronautical collaboration with the Americans should take a look at pages 938 and 948 of this issue, on which are published first details of the Boeing 727. This aircraft is in all major respects a carbon copy of the D.H.121 Trident.

Last February Sir Roy Dobson and Sir Aubrey Burke visited Boeing to discuss, among other things, collaboration on the D.H.121. Boeing were interested, and four senior de Havilland engineers, including the chief designer Mr C. T. Wilkins and chief technician Mr. D. R. Newman, went to Seattle also. Boeing engineers later visited Hatfield, and other exchanges followed.

I would not blame DH for feeling, to put it mildly, disenchanted with the "collaboration" that has resulted. I do not know whether they feel sore or not: I think they have been in the game long enough to have few illusions left to be shattered.

But I think I know one thing: henceforth, whenever the Minister exhorts DH—or anyone else in our industry—to collaborate with a foreign industry, he will be reminded of what happened when we tried it with the Trident.

Footnote: I am assured by a gambling friend that de Havilland hold a trump card—the three of Speys.

● "I believe that the Mach 3 aeroplane flying at around 2,000 m.p.h. will be the next generation vehicle for long-range air services. If we in this country do not build it the Americans—and Russians—will."—*Mr Peter Masefield, managing director of British Executive and General Aviation.*

"The thing that worries me is that somebody, on your behalf, will decide that you shall be conveyed in the 1970s in a 2,000 m.p.h. aeroplane. Take my advice and do not fall for it. If you say that you are not going to buy a ticket on anything faster than 1,500 m.p.h. for the next 20 years you will be acting in the best interests of the airlines, the aeroplane manufacturing industry, and your own physical well-being."—*Sir George Edwards, executive director, British Aircraft Corporation.*

● "Oh, good morning, Smith. Got an answer yet on that C_L max problem yet?"

"Yes, sir. My section has been working on it for three weeks now and we think we've got the right shape for the slat. I think we should get 2.6 without blowing."

"Mmm. Looks all right. Better get it in the tunnel. Get the model modified."

"It's being used to complete the stall programme, and Brown reckons it will take another six weeks even with the Pegasus going full bore. I thought perhaps we could make a new model . . ."

"A *new model,* Smith? Are you mad? It will cost at least £200."

"Yes, sir, but it will mean two months' delay otherwise . . ."

"Oh, all right, I'll put a chit through."

* * *

"Ah, Smith, come in. I have now heard from J.J. about the note I put through six weeks ago. I am afraid he won't stand for £200, so we'll have to modify the existing model. How is the stall programme going?"

"Well, it's nearly finished, sir. But the powerplant people want the model to complete their intake programme."

"Oh yes, I'd forgotten. Well, tell them to hurry up. This is urgent. We've lost two months on this lift coefficient business already. If we don't look out we're going to be even later on deliveries than we look like being already."

Smith [thinks]: "This £200 is going to cost the firm £200 million if we don't watch out."

● Approaching his Suffolk-based airfield in an F-101 Voodoo last week Capt J. E. Shephard, USAF 91st Tactical Fighter Squadron, found that he was unable to move the throttles from the idling position. With his airspeed dangerously low, and decreasing rapidly, he unfastened his safety belt and shoved the throttles open with his feet. Each time he took his feet off, however, the throttles closed to the idle position. And, just to make things more hazardous, transverse pressure on the throttles caused the afterburners to cut in and out.

It was, he said, after a perfect landing, "like sitting on top of a bucking bronco." The only damage: "Two slightly bent throttle levers."—From a report in *The Times.*

How fortuitous that an Air France photographer happened to be at hand when the "Duchess of Savoy" and her attendants—again by sheer good fortune wearing their national costume—named this Air France Caravelle "Savoie."

● RHODESIA'S AIR CHIEF TO SEE U-BOMBERS—headline in the *Leicester Evening Mail.*

"My dear," said the Victor to the Vulcan, "when I saw myself in the mirror—I mean looking-glass—this morning I sat down on the settee—sorry, sofa—and took out some perfumed notepaper, I mean scented writing paper . . .

"Oh, for goodness' sake, let's just be non-U-bombers, shall we?"

ROGER BACON

No XI in my "Life Goes On" series: a retired Lockheed Neptune of the US Navy is towed from Miami Airport down Lejeune Road on its way to a children's playground. Incidentally, the Helmy Aerogypt that I illustrated on December 2 was not being used as a chicken house in a garden in Woodley, but at White Waltham. Two other Life-goes-on club-members that kind readers have written to me about: (1) Cockpit of an Airspeed Horsa in use as a greenhouse at Badby, Northants, and other Horsas in use as garden sheds at Byfleet in the same county; (2) Saro Cloud G-ABHG in use as a caravan behind the "Rest-A-While" cafe at St Leonard's on the A.348 Ringwood to Bournemouth road—or at least it was there in the summer of 1953

Four Lockheed Jetstar executive aircraft on the line at Marietta, Georgia, where flight-testing is currently under way

Sport and Business

A MEMBER of *Flight's* staff recently hired a Piper Caribbean from Panshanger to fly to RAF Leeming in Yorkshire, because operations by *Flight's* Gemini had become impossible owing to the waterlogged state of Fair Oaks airfield. The forecast gave "little or no cloud; hazy near towns, otherwise visibility seven miles." About halfway to Leeming, however, visibility deteriorated sharply, a south-westerly wind bringing industrial smog from the Sheffield and Barnsley areas; and in the South Yorkshire area, with its complex of railways, canals and rivers, map-reading became difficult and it was hard to get a satisfactory pinpoint. Fortunately the pilot recognized the eastern suburbs of Leeds, realized he was about nine miles west of track, and altered course to 360°.

The haze suddenly turned to cloud blowing off the Pennines, and at 1,500ft the aircraft was under IMC. A call to Leeming on 117.9M/cs brought a QDM of 360°, but meanwhile the pilot was finding difficulty in controlling the Caribbean. Without an artificial horizon (only a "black ball" turn-and-bank indicator) and with the push-pull type of control column, he found himself over-correcting, so that the aircraft went into a series of dives and climbs; in addition the compass, pivot-mounted and read like a directional gyro, proved hard to follow without visual points of reference. Unfortunately, in one of the involuntary manœuvres the compass came off its pivot, so that QDMs from Leeming could no longer be followed. In this situation, the only course was to re-establish visual contact; and the first sight that appeared through a break in the cloud was the sodium lighting at RAF Dishforth. Permission was given (through Leeming) to land there, and the compass was put right in time for the homeward journey.

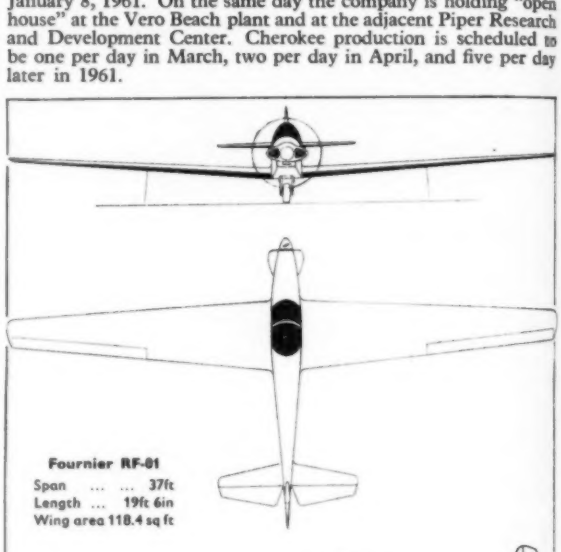
This is a cautionary tale; no excuses are made. It serves to show what may happen if one inadvertently gets into cloud in an aircraft with controls and compass of unaccustomed type and without a blind flying panel. The moral is, of course, to stay VMC; but on this occasion a combination of circumstances blew up so quickly as to forestall evasive action.

CHRISTMAS EVENTS at flying clubs in the London area include the Christmas party of Surrey and Kent Flying Club at Biggin Hill tomorrow (December 17); and that of the London Aeroplane Club at Panshanger on Friday, December 23. In London itself, the Kronfeld Club is holding its party on Wednesday, December 21.

CHANNEL ISLANDS AERO CLUB and Jersey States, the island parliament, are discussing the possibility of the club purchasing a Lake amphibian for air-sea rescue use. Such an aircraft would be based at Jersey Airport and would be manned by club members, assisted by volunteer airline pilots.

DATES for the second international glider trade fair, to be held at Lasham Aerodrome in connection with the 1961 national gliding championships, have been announced as May 13 and 14. A static display area for aircraft and vehicles is to be provided outside the exhibition hangar, and light powered aircraft as well as gliders will be featured. Details of exhibit space and costs are available from Sqn Ldr J. C. Ward, Nettlebed House, Nettlebed, Henley-on-Thames, Oxfordshire.

DEDICATION of the new factory of Piper Aircraft Corporation at Vero Beach, Florida, and probable roll-out of the first production Cherokee, is planned to coincide with the 80th birthday of Mr W. T. Piper, the company's founder and president, on January 8, 1961. On the same day the company is holding "open house" at the Vero Beach plant and at the adjacent Piper Research and Development Center. Cherokee production is scheduled to be one per day in March, two per day in April, and five per day later in 1961.



The Fournier RF-01 ultra-light single-seater, described in our issue of December 2, 1960, cruises at 90 m.p.h. on its 25 h.p. Volkswagen

ORDERS AND DELIVERIES for new model Beechcraft business aircraft amounted to more than $15.5m, representing over 20 per cent of the company's 1961 business-aircraft sales goal, within one week of the announcement of the 1961 range last month. During 1960, domestic sales of Beechcraft aircraft have risen to $52m, with export orders increasing from $4.7m to over $10m.

Designed and built by William Warwick of Torrance, California, the Warwick Li'l Champ is powered by a 65 h.p. Continental, has a span of only 22ft, and cruises at 95 m.p.h.

RETROSPECT

From "Flight" of December 17, 1910

London Aerodrome: Owing to the weather, there is very little of interest to record of the past week's doings. On December 6th Mr. Clutterbuck had out the Everett monoplane, but the engine was still working unsatisfactorily, and the machine did not rise, although most of the weight was clearly off the wheels. Next day, however, the engine did for a short time come to a sense of its duty, with the result that the machine took a 40-yd. hop. Then the engine again failing, it came to earth, and being caught by a gust of wind, went over on one wing and damaged one landing wheel. The Papin motoplane was outside tuning up, but retired again, as the engine was working somewhat erratically. In spite of the deluge of rain to which it has been subjected, the ground keeps tolerably hard and dry, the drainage system fortunately having exceeded the anticipations even of those who planned it.

Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. Names and addresses of writers, not for publication in detail, must in all cases accompany letters.

Col Lawrence—Aviator

MANY of your readers will be looking forward to the films dealing with the life of Lawrence of Arabia. Will these, I wonder, include his flying activities in World War One?

The official diary of No 1 (B) Sqn, RAAF (which started life as No 67 Sqn, RFC), records that on many occasions Lawrence flew in the observer's seat of the Bristol Fighter piloted by Capt Ross Smith, MC, DFC, and on some occasions flew with Capt G. C. Peters, DFC (also from Adelaide). On May 16, 1918, for example, Ross Smith flew to a spot in the desert from whence Lawrence, in Arab dress, made his way through the Sherif Nazir's tribal camps to Arab headquarters.

After several sorties with No 1 (Australian) Sqn (as 67 became known), the RAF formed "X" Flight to work with Lawrence, and several Australian crews with their mechanics left Ramleh to join Lawrence at Azrak. The sight of RAF "Tiyaras" ("female flying things") greatly encouraged Anglo-Arab entente and contributed much to the success of Lawrence's "tulip-planting," i.e., blowing-up Turkish forts and railways.

One burly digger pilot told Lawrence "You wouldn't make a batman to a padre" and seconds later cried for mercy as he lay writhing after a short bout of wrestling. "Gee," he said to his cobbers, "this pommie has muscles like piano-wires!"

Lawrence always hit it off with airmen and, in the year that Sir Ross Smith and Lt Bennett were tragically killed testing the Vickers Viking amphibian (1922), Lawrence joined the RAF as 352087 AC2 John Hume Ross.

Leigh on Sea, Essex LESLIE HUNT

"Do-it-yourself" Escape

IN the welter of correspondence on Sir Alan Cobham's late unlamented television series, I am surprised no mention has been made of another BBC programme. I refer to the popular *Spy-Catcher* series, advertised as being based on true stories of counter-espionage work during the last war.

In a recent episode the escape of a nobleman from Occupied France was described, apparently in a home-made "Bleriot-type" aircraft powered by the engine from his Rolls-Royce car. He was accompanied by his manservant (who later proved to be a Nazi agent) and the aircraft was escorted to an RAF airfield by Spitfires who spotted it over the Channel.

Is there any truth in this story and if so, are any details of the aircraft known? Apart from the Colditz glider I have heard of no other "do-it-yourself" airborne attempts at escape.

Bath, Som R. A. MILES

Prestwick: Domestic and International?

DOMESTIC airline operators, the rest of the world over, commonly demand that they shall be permitted to operate from the airports to and from which the international airlines fly: this is because quite a substantial proportion of their traffic is that connecting with international services.

Unless, therefore, the argument is put forward that Prestwick could not cope with the domestic traffic in addition to its international traffic, surely the Minister of Aviation ought not to spend additional public money to set up a separate airport for Glasgow to replace the unsuitable Renfrew (and Abbotsinch is unlikely to be nearer in journey time to the centre of Glasgow than Prestwick could be).

The total failure since the war to provide a decent train service to Prestwick (where now the runway has been extended right up to the railway about a mile from the existing station) has meant that

(a) the vast majority of normal traffic between Glasgow and Prestwick/Ayr is carried by double-decker 'buses, which run more than three services per hour throughout the day, all the year round, whereas, for example, British Railways run about two trains in the whole of Sunday,

(b) it has forced BOAC (who carry the interational airline passengers to and from Glasgow for all the airlines operating from Prestwick) to run a fleet of special coaches just for this job, but also

(c) it allows the other nationalised domestic transport operator, viz, BEA, to say "that interests of internal passengers (would be) better served by using an airport nearer to Glasgow than (is) Prestwick."

BEA's comment must be respected from their limited point of view: but currently BEA carry very few indeed of the passengers for the international services from Prestwick (largely because the connection between Renfrew and Prestwick is so tedious that most passengers prefer to go to Prestwick by other means). But airport plans are for the years ahead, and since these envisage a large increase in the international traffic from Prestwick (including freight on a large scale) being drawn from the environs, a good train service from Glasgow will be essential in any case: but the delay to international passengers brought from other parts of Scotland by BEA will be one of hours to get from Abbotsinch to Prestwick.

The reason we tolerate transport monopolies in this country is on the understanding that the operator takes the rough with the smooth: it is all very well for BEA to say, "let others operate the international feeder air services to and from Prestwick"; they know only too well that this traffic *alone* is insufficient at present: it's all "rough"—whilst they carry only the domestic traffic, and to make it "smooth" for them, they are going to give very poor service indeed to the international passengers through Prestwick.

Yet if Prestwick (which is *essential* as a diversionary airport because it is the only fog-free airport in the UK) could handle all the Glasgow area air traffic, domestic and international (and this is something I would suggest the Minister should give his views on), BEA would be doing justice to the "rough" as well as to the "smooth" by operating to Prestwick when Renfrew closes, and the overall economy would benefit everyone (the taxpayer not least!).

For one thing, Prestwick, Manchester and London all have runways capable of taking the largest aircraft in existence: to make the new Glasgow runway far shorter than either of the other two are now, would one day preclude operation of such types of aircraft into the "Glasgow domestic" airport: for many years airline traffic is expected to go on doubling every five or six years (as it has been doing in the past), so the time when very large aircraft will be needed may be no more than 10 or 12 years off: then the folly of choosing an unnecessarily short runway for Glasgow will have to be paid for by the passengers in higher fares.

Lytham St Annes, Lancs J. F. VOSS

Lawrence of Arabia (wearing trilby) with King Feisal (the bearded figure in Arab costume) and World War 1 friends. Mr Leslie Hunt, who sent the photograph and whose letter appears in col 1, asks if any reader can identify the Sidcot-suited pilot

The First Night Flight

COULD you spare room for even more history, in the form of what appears to be an unbreakable claim to the world's first night flight, and an answer to the interesting letter [November 25] from Mr Nettleinghame? First let me take the latter.

My reason for saying that Henri Farman spoke "next to no English" was that this actual phrase was used to me the other day by an eminent English pilot who learnt to fly at Issy late in 1908, and knew Farman at the time in question. I also remember my friend the late Col Harry Delacombe saying that Henri did not speak more than a few words of English, and saying that they joked about this at a dinner at the Blackpool meeting of 1909. Then, as to my remark about the signature of the note being in a different hand to that of the text: surely the two hands are completely different. The vigour of the signature, the type of capital F, and the whole "configuration" of the writing is different. And look, too, at the idioms he uses, "for not being with you," "most of my time," "I must also be of some help to," etc, etc.

Now for the first night flight. I questioned M. Dollfus, as I promised, and he tells me that there are now documents (and the surviving pilot himself) to show that the first night flight in history was made by the well-known French pilot Emile Aubrun on a Blériot type XI, in the Argentine on March 10, 1910. At 9 p.m. on that date he took off from Villalugano (a suburb of Buenos Aires) and landed at the hacienda of a Sr E. Madeiro (a judge) just over 20km away, the flight taking about 20min. He flew back the same night, landing at Villalugano at 11 p.m.

Being of a suspicious nature, I asked Her Majesty's Nautical Almanac Office about when darkness falls at that precise spot. They tell me that astronomical twilight (full darkness) occurs there at either 7.52 p.m. (local mean time) or 8.46 p.m. (standard

The Convair XC-99 and its 400-man load, referred to in the letter from Mr R. P. McBride

CORRESPONDENCE . . .

time). The Argentine Embassy kindly verified that there is indeed a suburb of Buenos Aires called Villalugano, and that—interestingly enough—there is to this day a small military airfield a few blocks from the local railway station.

I also asked M. Dollfus about the Farman claim, and he said that Farman did not particularize beyond the "Spring of 1910." So I think we can take it that Grahame-White was the first in Europe to make a night flight, on that famous 28th of April 1910, soon after 2.30 a.m.

London W1 CHARLES H. GIBBS-SMITH

[P.S.—You must forgive my uncle for writing that vulgar little note in your November 18 issue, although I agree with most of it. He waits till I am out of the house and then sneaks off to the letter-box. He does it out of pique at my having changed my name to the equally undistinguished, but more euphonious, form I append above.]

Wüsthoff's Last Flight

WHILE looking through *Flight* of August 26 I noticed on page 306 a picture of the scrap which was Wüsthoff's last flight. The book mentioned [*Fighter Aircraft of the 1914-18 War*] is one I will be looking forward to seeing, but it's a pity that the frontispiece should be wrong.

This scrap took place in a large cloud-bank at very high level between about 25 to 30 aircraft, but only two SE.5s followed Wüsthoff down and forced him to land in the first support trench area between the village of Cashey and Villers Bretonneux.

If I remember rightly a Capt McDonald was the pilot of one and both were of the 24th Squadron. Capt Southey of South Africa was the pilot who was given credit for putting a bullet into Wüsthoff's hip. Wüsthoff's brand new Fokker D-VII was hardly marked when it landed and turned over on its back, tossing the pilot out on to the ground.

This was the first enemy ace to be captured alive behind the Allied lines in World War One and he was not captured by the French. This credit goes to three Australians—Lt Symes of Queensland, Gunner R. Griffiths of Melbourne, Victoria, and Gunner J. W. A. McGregor of St Arnaud, Victoria. When it was found that he was badly wounded, Wüsthoff was handed over to French Army medical men. Another point, Wüsthoff's Fokker did not have the skull and crossbones painted on it.

How do I know all this? Well, at the time, three of us had an 18-pounder gun hidden in the support trenches held by French African troops, the idea being to act as an anti-tank gun if Fritz made an attack with captured British tanks. The attack never came and no one was more pleased than we were.

I watched this scrap in the air from start to finish and was first to reach Wüsthoff when he rolled out. His ticket showed 27 victories, of which 19 were balloons and eight aeroplanes; his age was 19 years. He died in July 1926.

A rather full report of this was published in *Air Stories* (London) in 1937 or 1938. Three months before this we saw the Baron shot down in front of Heilly, just close to our battery, on April 21, 1918.

Nyah-West, Australia J. W. A. McGREGOR

(27th Battery Australian Field Artillery, 1st A.I.F.)

"Record" Passenger Loads

WITH reference to Mr Bateson's letter (*Flight*, August 19) asking for information on the largest number of adult people ever carried in an aircraft, I enclose a photograph I came across in an issue of the *National Geographic Magazine* which depicts 400 men entering a Convair XC-99.

The statement under the photograph only says that the 400 men or 50 tons of cargo could be carried in the XC-99, but I think it is quite reasonable to assume that at some time such a number was carried, if not immediately after the photograph was taken.

Can anyone better this?

Birkenhead, Ches ROBERT P. McBRIDE

THE INDUSTRY

Dropping in on GQ

IN a dwelling-house-like building in Woking last week was opened a new research and development department of the GQ Parachute Co Ltd. Standing adjacent to the present factory, it was built in that style to satisfy the planning authorities, and it has turned out to be a more-than-fair attempt at confining functional needs within the discipline of domestic architecture.

The building answers a clamour—surprisingly urgent in view of the timeless analogy of the parachute as "a tablecloth with a string at each corner"—for room in which aviation and industrial developments can be studied and new techniques devised. Included among these are the airborne dropping of heavier and heavier loads (the GQ record, from the RAE Beverley, is now 44,000lb); the production of a range of utility parachutes, originally considered expendable, which are two-thirds cheaper than those they replace; and development of new canopies for paratroops and ejection sequencing equipment for fighter pilots.

By no means has the limit of load been reached in heavy dropping; eight 66ft-diameter canopies (an acre and a half of nylon) were used on the 44,000lb drop and nine could theoretically sustain another 1,000lb or so. Development work on better forms of shock absorption—compressed-paper structures, shock struts, air bags, and so on—should allow dropping velocities to be increased, and changes in the design of canopy packings should reduce the minimum height from which these big loads can be released. The weight of the canopies employed has now been reduced to one twentieth of the weight of the load, a 100 per cent improvement over the original specification.

The appearance of a braking parachute differs according to whether it is of "ribbon" or "ring-slot" design. The gores of the former are a number of ribbons, normally 2in wide and separated by gaps of approximately ½in. The ring-slot gore consists of fabric strips up to 17in wide with gaps of 3in to 4in between them. GQ favour the latter type and, having done much to develop the ring-slot canopy, believe it to be the cheaper to manufacture. This type is supplied for the Gnat (7½ft diameter), the NA.39 and the Victor (45ft diameter).

A general specification for parachutes of this type calls for full deployment in 2-5sec, stability within a 10° cone angle, and the capability of being repacked and re-used between ten and fifty times (an average drag-chute life). Another requirement is the addition of a weak link which will fracture should the drag of the parachute be such that it exceeds the strength of the structure.

Parachute manufacturers have their own requirements for aircraft manufacturers. One of these is that the aircraft stowage should be waterproof—drag parachutes exposed to damp and then to cold tend to freeze solid.

IN BRIEF

BOAC have placed with Ultra Electronics Ltd a £31,000 contract for engine condition analysers for use on the corporation's Comet 4s.

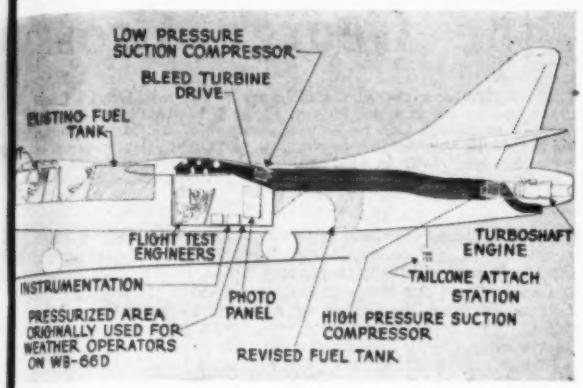
Mr A. I Helm, hitherto plant engineer of Skefko Ball Bearing Co Ltd, has been appointed works manager of the company's proposed new factory at Irvine in Ayrshire.

We regret to learn of the death—in a motoring accident on November 21—of Mr T. P. W Norris, MBE, MC, deputy chairman of George Kent Ltd. Mr Norris, who was 68, joined the Kent board in 1958 from the Vickers Group, where he was chief personnel officer.

A new British standard for *Bolts and Nuts for Aircraft (General Clauses) A.100: 1960*, is available from the British Standards Institution, Sales Branch, 2 Park Street, London W1, price 10s (postage extra to non-subscribers).

A short *Guide to the Drafting of Specifications for Rubber Products* has been published by the Federation of British Rubber and Allied Manufacturers. Copies are obtainable free of charge from the secretary of the Federation, at 43 Bedford Square, London WC1.

The entire fleet of Vickers VC10s for BOAC are to be fitted with fuel contents measuring equipment designed and manufactured by Waymouth Gauges & Instruments Ltd, one of the Smiths Group. This order, placed with Smiths Aircraft Instruments Ltd by Vickers-Armstrongs (Aircraft) Ltd, is the largest ever received for equipment of this type. The contract also calls for the provision of ground testing and maintenance equipment for BOAC. The VC10 will have a specially developed version of the Smiths-Waymouth Type 4 transistorized fuel-contents gauge, which will also incorporate facilities for precise control of refuelling and defuelling during ground handling.



Published for the first time is an inboard profile of the "technological airplane" evolved by Northrop from the WB-66

NORTHROP'S LFC

By an American Correspondent

THE United States Air Force and Northrop Corporation are embarking on an ambitious programme for evaluating low-drag, laminar-flow BLC (boundary-layer control) which may lead to its full-scale introduction into Military Air Transport Service operation by 1965. At a one-day symposium held at the Norair Engineering Science Center in Hawthorne, California, on October 13, a panel of Northrop engineers outlined their progress.

The whole programme is the result of painstaking research on laminarizing boundary layers during the past 12 years by a Northrop team led by Dr Werner Pfenninger. This work has closely paralleled that of Dr G. V. Lachmann of Handley Page. It has now come sufficiently far for Northrop to feel confident that LFC (laminar flow control) is feasible on full-scale swept wings.

Some laminar-flow researchers have sucked off the boundary layer through perforated skins, or even panels of sintered material, but Northrop's technique is to cut slots running along element lines the whole length of the wing. The slotted outer skin is supported by a heavier layer which has 0.06in holes drilled through grooves. Both sheets are bonded in a honeycomb sandwich. The slots are machined at the rate of 20ft/min, and vary in width from 0.004in to 0.010in, with an accuracy closer than 0.0003in. The thousands of holes in the inner skins are drilled on automatic machines at the rate of 200 per minute.

Tunnel tests have confirmed that the theoretical computations of boundary-layer growth and stability on swept wings accurately predict the suction requirements. What is also important, the tests have indicated how much surface roughness (about 0.005in r.m.s.) and how much waviness (amplitude not more than 1/400 of the wavelength) is acceptable. These figures vary with the position of the irregularities along the chord, and also with altitude. However, it is believed all the requirements can be met with the manufacturing techniques already developed at Northrop, with only a small increase in cost over that for modern turbulent wings. Maintenance analyses also indicate that no unusual skills or equipment will be required, and that daily inspection and cleaning of the wing, and periodic checks of waviness, gap clearances and trouble-shooting of instruments, will add only 10 per cent to total maintenance cost.

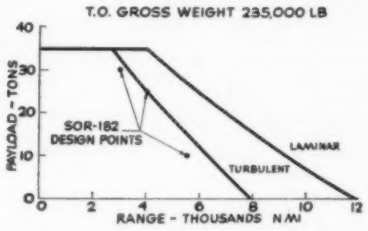
As reported in *Flight* (of September 9, 1960, p. 403) Northrop has received the USAF's go-ahead for demonstrating LFC on a "technological airplane." Two Douglas WB-66D aircraft are being completely rebuilt for these tests. Since for maximum L/D the profile drag (due to friction and wake) must be equal to the induced drag (due to the generation of lift), the new suction wing will be considerably larger in area than the present turbulent wing (1,250 sq ft compared with 780). Secondly, in place of the obsolete J71s of the B-66, the new build will use Pratt & Whitney TF33 fans. Besides their much improved specific consumption, these engines are comparatively quiet; Northrop are concerned about the effect of engine noise on the stability of the wing boundary layer, and believe this should not exceed 95db. To help minimize the noise and vibration on the wing the engines will not be slung from the wings but mounted on the aft fuselage. This will involve a huge c.g. shift, and indicates how extensive these rebuilds will be.

The third major change will be the addition of a suction power system. To conserve power the air sucked from the wing will be manifolded at two pressure levels: that from the leading edge and upper surface at about one-third ambient pressure, and from the lower surface at about one-half ambient. Two-stage compression is thus required, to pump the lower-pressure air up to the next level, and then to raise the whole flow—estimated at about 1,000 cu ft/sec—to a pressure of 1.5 atmospheres, so that it can be exhausted at a speed somewhat greater than that of the aircraft and yield positive thrust. Present thinking is that the low-pressure compressor will be driven by a bleed-air turbine, and the high-pressure compressor by an ungeared turboshaft engine—either the Pratt & Whitney JTFD-12 (4,050 s.h.p.), Lycoming T55-L-5 (2,200 s.h.p.), or General Electric T64 (2,700 s.h.p.).

Ground test of the first aircraft is scheduled to begin in June 1962, and flight test in September. Test observers will use the pressurized compartment amidships, where they can monitor airflows, pressures and miles per gallon. If all goes well the programme will be completed in the middle of 1963, when the two aircraft will be handed over to the Air Force. Manager of the programme is Mr Milton Kuska.

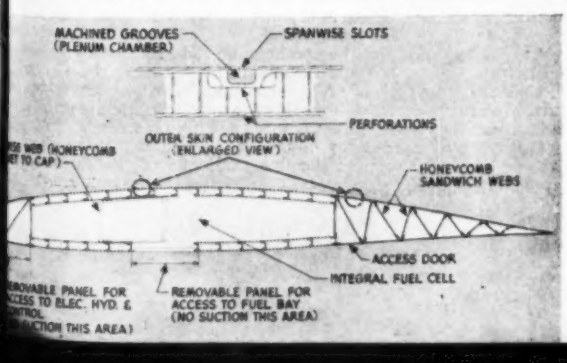
Naturally the chief interest behind such a demonstration programme lies in the prospects of using the technique in production aircraft. Although the range and payload gains obtainable from laminarization have been known for many years, LFC has not been considered an urgent development because SAC's highly developed air refuelling has made possible round-the-world range. But this technique is not considered feasible for troop and cargo transports, and, faced with the possible loss of many overseas bases, MATS now has urgent need of transports of great range. General White has listed a modernized cargo fleet as one of the USAF's "Ten Top Priorities," and over $250m has been allocated for it in the current fiscal year. A contract for a new cargo jet (Specific Operational Requirement 182) will be awarded to one of the four West Coast manufacturers by next April. Northrop have calculated how the performance could be improved by laminarizing the wing and tail; they believe that if the test programme goes according to expectation, LFC could be phased into this production programme after the 24th aircraft.

SOR-182, for the Military Air Transport Service, is discussed in the text immediately below. This diagram indicates the enormous improvement effected by laminarization; payloads are in short tons of 2,000lb



It is almost unprecedented for an airframe manufacturer to give full details of its proprietary design and manufacturing techniques to the rest of the industry in this way. In this context Northrop regard themselves as propulsion specialists—suppliers of wings and suction power systems to the major transport builders. In this they have no competition at present, and so may obtain a substantial slice of future air transport business.

How significant is this development? At the International Aeronautical Congress in Madrid two years ago Dr Lachmann said: "Achievement of full-chord laminar flow in flight . . . constitutes a major aerodynamic breakthrough, of the same order as that due to the replacement of biplanes with fixed undercarriages by the clean cantilever monoplane." Once it was known how to build cantilever wings it suddenly became worthwhile to retract the wheels and flaps, enclose the cockpit and cowl the engine and radiator. Now that a determined effort is under way to control laminar flow, another similar chain reaction can be predicted for the coming decade, leading to lower wing loading, more capacious fuselages, and relatively smaller engines and fuel tanks. Military transports may be able to move troops and supplies to quite small airfields 3,000 miles away and return without refuelling, while the growth of intercontinental commercial air freight can be expected to parallel the rise of passenger travel in the fifties.



This diagram indicates the mechanical arrangement of slots and wing structure, which bears no relation to that in the original bomber

Air Winners of the George Cross

TOMORROW sees the 20th anniversary of the first George Cross awards. In the article which follows, Flt Lt J. L. Hunt recalls acts of gallantry which won GCs for aircrew members of the Commonwealth Air Forces. He referred in a recent letter to "Flight" (December 9) to the action over Malta in 1942 which cost the life of Wg Cdr Noel Dowland, GC, and asked for further information about it.

THE *London Gazette* dated December 17, 1940, made history, for in that issue appeared the first list of George Cross awards. The decoration was instituted on September 24, 1940, when the London blitz was at its height; and during King George VI's epic broadcast giving details of the new awards, a raid was in progress and the "all clear" was heard by those listening to His Majesty.

When the George Cross was instituted, 18 awards of the Empire Gallantry Medal to members or ex-members of the Royal Air Force had been recorded and 16 of these survived to receive the George Cross upon relinquishing the EGM. LAC Breadon and Plt Off Branch died before the announcement of the GC and, unfortunately, there were to be no fewer than 18 of the 24 GCs awarded posthumously or to men who died following the award; in addition six of the EGM holders died during or shortly after the war, leaving only 16 living recipients of the award to the Royal Air Force and the WRAF.

Of the 40 GCs, ten were gained either in the air or by members of aircrew involved in accidents to their own aircraft, the first award being the EGM to Capt Patrick Taylor during the famous flight from Australia to New Zealand by Kingsford-Smith on May 15, 1935. The *Southern Cross* was transporting the King George V and Queen Mary Silver Jubilee air-mail covers when, half-way across the Tasman Sea, a piece of exhaust manifold was whipped by the slipstream into the starboard prop. The engine was stopped, freight, luggage and all spares being tossed overboard as the plane rapidly lost height. Then, with the pressure dropping on the port engine, Capt Taylor, who was co-pilot, climbed out on to the wing, making six trips transferring oil from the dead engine to the port motor, carrying the precious lubricant in his thermos flask. Alas, it was too late, and the cargo of 35,000 first-day covers had to be jettisoned. The aircraft, however, safely reached Mascot Airport, Sydney, and preserved for posterity, now rests in a glass showcase at Eagle Farm Airport, Brisbane. Patrick Taylor, who had won the MC with the RFC, exchanged his EGM for the George Cross on June 13, 1942, and was later knighted for his services.

It was 17 days after the outbreak of World War Two that the second "air" award was gained when Fg Off Reg Graveley of No 88 Sqn was detailed with two other Fairey Battle pilots to patrol a section of the Maginot Line, where they were jumped by a force of Me 109s. Graveley managed to crash-land his blazing aircraft just inside France and, though badly burned, pulled his wounded observer to a place of safety, returning to rescue the air gunner—only to find him dead. Unfortunately the observer also succumbed to his injuries. This award is of particular interest in that King George invested Fg Off Graveley with the EGM "in the field," at Plivot Aerodrome in December 1939, believed to be the only occasion of its kind in the history of the award. Graveley later joined Gloster Aircraft as a test pilot and now operates a private company specializing in commercial and air photography.

The last of the RAF EGMs went to Plt Off Don Parker, RAFVR, captain of a bomber which crashed just after take-off on the night of June 8, 1940. The aircraft immediately burst into flames but, with complete disregard for his own safety and knowing there were four 500lb bombs in the blazing wreckage, Parker returned and carried his wireless operator to a place of safety. During this time one of the bombs exploded and Parker saved the airman further injury by throwing him to the ground. After a tour on night-fighters and a DFC award he was posted as a squadron leader to No 61 Sqn at Syerston, losing his life when his Lancaster was shot down over Germany in January 1943.

Three air winners of the George Cross: from left, Plt Off (later Sqn Ldr) Don Parker; Sqn Ldr Alan Quinton, whose name is commemorated in the Quinton Trophy, an annual ATC award; and LAC K. M. Gravell, first RCAF airman to win the GC

The Auxiliary Air Force gained its second GC through Fg Off Tollemache, when his aircraft crashed after a searchlight exercise and he tried, in vain, to rescue his trapped passenger, suffering injuries which nearly cost him his own life.

A year later, in March 1941, Sgt Raymond Lewin was awarded the GC for an action in November 1940 when his bomber crashed into a hillside after take-off. He ran round the blazing wing, in which full petrol tanks were burning, to rescue his injured second pilot. Despite his own severe injuries he dragged and carried the airman some 40 yards to a hole in the ground where he lay on him as the bombs exploded. Sad to relate, Lewin did not survive to receive his GC.

Two GCs were won in the air over Canada, and the RCAF became the first Commonwealth air force to gain the award when, in June 1942, a posthumous George Cross was announced to LAC K. M. Gravell who was under training as a wireless operator/air gunner when the aircraft in which he was flying crashed and burst into flames. In spite of the intense shock caused by the loss of an eye and severe burns, Gravell's first and only thought was for his pilot. Ignoring his own serious injuries and the fact that his clothes were ablaze, he attempted to get back into the aircraft to pull the pilot clear. Had he not considered the pilot before his own safety he would probably not have lost his life.

In January 1944, another GC went to the RCAF—to LAC K. G. Spooner of No 4 Air Observer School, a student-navigator who was undergoing instruction in an Anson when the pilot collapsed over the controls. As the plane dived towards the ground, Spooner, who had no pilot training, took control and kept the aircraft steady whilst three members of the crew baled out to safety. The pilot and Spooner were killed when the plane crashed into Lake Erie a few seconds later.

Middle East Heroism

Another posthumous award to the RAF had meanwhile been gazetted, to Sgt Graham Leslie Parish, an observer who had completed a tour with Bomber Command's Halifaxes and was en route to the Middle East with a delivery aircraft. Taking off from a Sudan airfield an engine failed, and the plane crashed into buildings as the pilot vainly tried to land. When the smouldering wreckage was examined it was found that the two casualties were Sgt Parish and the civilian passenger, a meteorologist. The passenger had both legs broken and his body was discovered with his arms over the sergeant's shoulders, by the rear exit. It was clear that Graham Parish had gone to the injured man's aid and, in trying to get him to safety, had sacrificed his own life.

Yet another GC went to the RCAF after a Wellington was shot down into the Atlantic by a U-boat. Fg Off R. B. Gray and three other members of the crew managed to extricate themselves and, notwithstanding a severe leg injury, Gray succeeded in inflating his own dinghy and assisted his wounded captain into it. Cries were heard from another crew member who had broken his arm and Gray helped him into his dinghy, refusing to get in himself, though in great pain. He eventually lost consciousness and died, by his unselfish heroism enabling the lives of his comrades to be saved.

The last GC for an airman was also a posthumous award, to Flt Lt John Alan Quinton, DFC, who, after serving with great distinction as a night-fighter navigator with No 604 Sqn during the war, returned to the Service in 1951. Shortly afterwards he was on a training flight in a Wellington, with a 16-year-old ATC cadet in his care. Another aircraft collided with them and, clipping his own parachute to the cadet's harness, Quinton pushed the boy through a gaping hole, just as the Wellington spiralled down, all eight officers being killed.

At Quinton's inquest the coroner said "He was a very gallant gentleman," and this could be said of all to whom the George Cross has been awarded; for King George VI, whose idea it was, conceived the decoration "for acts of the greatest heroism or most conspicuous courage in circumstances of extreme danger."

On the 20th anniversary of the first awards we salute those who so gloriously upheld the fine traditions of the Royal Air Force.

LESLIE HUNT

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Capt A. S. Johnson, BEA's Vanguard flight manager, receives from Brian Trubshaw, Vickers' chief test pilot, the Vanguard's ARB flight manual at Wisley on December 2—the moment in which BEA's order placed in October 1955 was fulfilled. Shortly afterwards Vanguard G-APEE was flown by Capt A. S. Johnson and his crew to Stansted for crew training prior to services starting over the Christmas period. Also in the picture are Mr J. Golding of BEA, Capt M. R. Chick of BEA and Mr M. C. Crisp of Vickers. See note in col. 1

AIR COMMERCE

VANGUARD IS UP ON PERFORMANCE

THE award of full unrestricted certificates of airworthiness for the BEA Vanguard 951 and TCA Vanguard 952 was announced on December 2. The flight manual for the V.952—which is basically the version offered to other operators—shows that airfield performance is well above original estimates. The datum performance guaranteed by Vickers, with the usual percentage deduction, at the drawing board stage has been surpassed. There is therefore a bonus to TCA on the figures, on which the Canadian airline placed its order.

For example, from a sea level runway of 5,000ft in standard temperature ISA conditions the V.952 can take off at a weight of 135,000lb, compared with the original specification weight of 122,000lb. Alternatively, runway requirement in this case of 5,000ft compares with the original estimate of 6,000ft.

There are also significant improvements in climb-out performance and landing distances, while the estimates of the aircraft's climb and cruise performance, which are generally more closely predictable, have been proved, say Vickers, "exceptionally accurate."

In addition to the improved performance, design development has given the Vanguard better load-carrying capacity, the maximum payload being dictated by structural rather than performance considerations. Under typical TCA operating conditions the Vanguard will have a maximum payload of 28,000lb, compared with the previously forecast figure of 24,000lb. In practice this means that the freight and mail carrying capability of the Vanguard will be better than TCA originally anticipated.

Certification of the Vanguard marks the completion of a 22-month test programme in which about 1,900hr have been flown by twelve aircraft in the course of more than 1,100 flights.

MANCHESTER AND BOAC's 707s

IN reply to local criticism in Manchester that BOAC's transatlantic 707 services from London have been over-flying Manchester Airport, BOAC have issued the following statement:—

"The runway is short and its surface is comparatively smooth by present-day international airport standards. Water remains on the surface after rain in greater quantity and for a longer time than is usual. The level of the runway rises along its length from the south-west to a point towards the north-east end. This point is about the normal touch-down position for a 707 landing towards the south-west into the prevailing wind; such a landing is therefore performed downhill. The wind direction is frequently across the runway. There is no ILS installation for approaches towards the south-west.

"One, or even more, of these factors would not necessarily present any appreciable problem, but in total they have been considered by our operations department to be sufficient reason for setting BOAC's landing limits (i.e., the minimum weather conditions in which a pilot may land his aircraft) rather higher than at other airports.

"BOAC is in touch with Manchester Corporation, particularly the Ringway Airport authorities, with a view to the improvement of the runway conditions. The lengthening of the runway by 500ft would greatly ease the present position; improvement of the runway surface and drainage would help considerably."

Since 707 operations through Manchester began on October 16 20 out of 49 flights scheduled to land at Ringway have been unable to do so; and the corporation, in response to protests, has announced new procedures to "reduce to the minimum inconvenience and delay to Manchester passengers when over-flying occurs." Broadly these provide for chartered aircraft to take passengers from Manchester to London for the direct Monarch service, or to Prestwick to join the flight that should have stopped at Manchester. When occasion demands there will also be cars laid on to carry passengers to or from Prestwick or Glasgow.

GHANA GETS ITS IL-18s

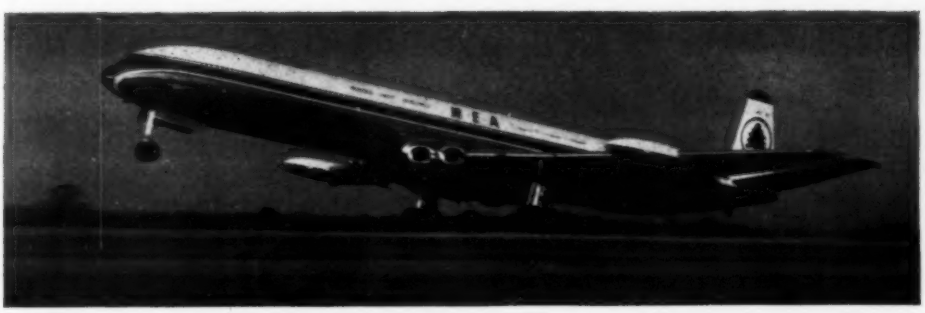
AT Accra on December 3 Soviet crews delivered the first two of six Ilyushin Il-18s ordered by Ghana Airways last September. Initially Russian pilots will operate the aircraft on Ghana Airways intra-African routes until such time as Ghanaian crews have been trained, and Soviet engineers will service the aircraft until the training of Ghana Airways engineers is completed.

The Ghana Airways fleet is now the only one in the world to comprise Russian, British and American aircraft: two Britannias are used for long-haul services, primarily at the moment to London, and two Herons and two DC-3s are used for local services. The Ilyushins will be used on routes between Accra, Lagos and Dakar to Addis Ababa via Kano and via Leopoldville to Nairobi.

CERTIFICATE FOR THE ARGOSY

DURING the same week that the Vickers Vanguard was certificated and delivered, the AW.650 Argosy was due to pass the same milestones in its career. FAA certification was completed and the first of Riddle's seven aircraft was (subject to fog) due to be handed over and flown to Miami to start work on the airline's three-year MATS "Logair" contract.

Some changes to the design were called for by the FAA. The aircraft—though of course suitable for two-crew operation—has been fitted for a crew of three, and two extra crew seats have been provided on the flight deck to carry "stopover" crews. The whole fuselage has been lined throughout to US requirements with fire-



Seen making its maiden flight at Hatfield on December 3 is the first of four de Havilland Comet 4Cs for MEA. Scheduled services will start in January. All four aircraft will be delivered by the spring. Pending delivery MEA have been operating a chartered BOAC Comet on a twice-weekly service between London, Beirut and Bahrein

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proof material, and a crew escape hatch has been fitted in the upper fuselage (this will become standard on all Argosies). A flight recorder is installed and a fuel jettisoning system is provided. High-intensity anti-collision lights are fitted, US radio equipment is installed, and provision has been made for American radar. The first aircraft will be delivered to Riddle fitted with AWA's Rolamat freight loading system.

An option on eight additional Argosies has been placed by Riddle. This, the airline says, will be "exercised as civil and military requirements dictate." In a statement about the Argosy, Riddle say that their pilots have found the aircraft "to be highly manœuvrable and have praised its speed, performance and ease of handling. Mechanics have been similarly impressed with the Argosy's simplicity and straightforward design." As one of America's all-cargo specialists, Riddle presumably weighed their words carefully before saying: "All other civil cargo aircraft in existence today are converted or compromised passenger designs, requiring extensive modification for cargo use [tending] to be difficult to load and costly to operate."

Footnote: The Argosy is the first British transport to be operated initially by an American, or indeed any non-British, airline.

VISCOUNT SCORE: 425

THE number of Viscounts on order reached 425 last week when a contract was signed by the German airline Flugdienst for one V.814. This aircraft will be similar to the nine Viscount 810-series operated by Lufthansa, with which Flugdienst is associated. Delivery will be made next summer.

Though the Viscount 700-series is out of production, the line at Vickers factory at Hurn has still to deliver nine V.810s, including the latest order—a total of 416 Viscounts of all series having been delivered since 1953. It is reported that Middle East Airlines are expected soon to announce an order for three Viscount 810s, for which it is said Viscount 700s will be traded-in.

US/UK SUPERSONIC COLLABORATION

ACCORDING to the *Wall Street Journal*, an agreement in principle between the UK and the US to collaborate on the development of a supersonic airliner envisages production of the aircraft in both countries. But both the details and the broad conception of the product, it is said, remain to be decided in further inter-governmental talks. The report indicates that the Americans are insisting on Mach 3 while the UK has so far preferred the Mach 2 aircraft.

It is said that the Eisenhower Administration is preparing to ask Congress for an appropriation for the financial year starting June 30, 1961, to initiate the programme, and it is said that the door to this decision was opened by the move last October to speed development of the North American B-70 Mach 3 bomber. Since President-Elect Kennedy's advisers are strong supporters of the B-70 it is presumed that they will go along with plans for a supersonic airliner.

In the Commons on December 5, when asked to state which "Commonwealth or European interests he is seeking co-operation for the development of the supersonic airliner," the Minister of Aviation, Mr Peter Thorneycroft, said: "My Ministry is in close touch with the Federal Aviation Agency in the United States, and I have also discussed this question in Paris. I do not rule out co-operation with other countries but, for practical reasons, this would no doubt have to be limited to the countries which are able to make a substantial technical and financial contribution."

FIRST OFF THE LINE

THE first of two Canadair 540s for Quebecair was delivered by Canadair to the Canadian airline earlier this month. A second has been ordered, and both will be used on Quebecair's routes between Montreal and north-eastern Quebec and other areas. Delivery of the second aircraft is due "soon."

Since August Quebecair has been operating, on what is believed to be a lease-lend arrangement, one of Canadair's demonstration 540s. Quebecair is the second operator of Canadair 540s, the other being Allegheny Airlines of Washington, who have six Convair 540s in service or being delivered. These are converted Convair 440s; Quebecair's two aircraft are the first completely Canadair-built 540s off the Montreal line.

JP.1 v JP.4

THOUGH invited by *Flight* to do so, no user of JP.4 (gasoline-based) fuel has answered the technical case against it that was argued in this journal on June 10, 1960. The only published case for the use of JP.4 emanates from TCA; and though their statement dates back to July (when Lord Brabazon made his first criticisms of the fuel) it is revived now in the light of the heightened controversy:—

"Gordon R. McGregor, president of TCA, today categorically denied that the use of JP.4 fuel in turbine-powered aircraft represented a hazard to the travelling public as charged by Lord Brabazon of Tara, chairman of the Air Registration Board in London. Mr McGregor pointed out that while some carriers employ kerosine many others prefer the use of JP.4 for well-established technical reasons. Both fuels, he said, are less volatile and inflammable than normal high test aviation gasoline. Whilst it is true that kerosine is less inflammable than JP.4 under some conditions, he said the reverse is also true and JP.4 has very real safety advantages under certain in-flight conditions when static electricity and other factors become involved.

"There has never been a fatality in a passenger-carrying turbine aircraft using JP.4 at least in the western world, said Mr McGregor. TCA chose JP.4 fuel after the most rigorous technical study and did so in the interests of operational safety even though the airline was initially told by the oil companies that this would be a more expensive fuel than kerosine. TCA, said Mr McGregor, places safety beyond every other consideration and would never consider for a second the use of an aircraft fuel that it did not believe to be the very best available. JP.4, he pointed out, has been used by TCA in its Viscount aircraft since April 1955 and has been found extremely satisfactory."

The three sponsors of the Boeing 727 (see elsewhere in this issue) are seen here after their news conference: from left to right, Mr Malcolm A. MacIntyre, president of Eastern Air Lines; Mr William Allen, president of Boeing; and Mr J. A. Herlihy, vp engineering, United Air Lines

PILOT REPORT ON THE 707

IN this week's reports on the Boeing 727, on pages 938, 948 and 962, Boeing are quoted as saying that the aft-mounted engine installation eliminates yawing tendencies due to asymmetrical power should an engine ever fail. This statement has obviously to be viewed in the light of 707 experience; and this is an opportunity to record remarks recently made in the US magazine *Air Facts* by a TWA skipper, Capt Robert Buck.

It must be emphasized that his remarks are taken out of context, and that the complete article (which appeared in consecutive issues of the magazine) is a masterly appraisal of the qualities of the big Boeing jet. It must also be borne in mind this was written about an aeroplane which was not then modified to incorporate the bigger fin and increased rudder boost subsequently fitted retrospectively and made standard on all production aircraft. Describing his conversion training Capt Buck says:—

"An engine out is quite a thing. Power-wise there's no problem; the airplane has plenty, and even with two engines out she can haul herself out of a tight situation. You just fly the proper numbers and she'll go. But keeping her under control is another matter. It takes a strong leg: the rudder is a monster.

"Of course in normal flight the rudder isn't a problem, but cut an engine and life gets very interesting. The part of the rudder we liked least was at low speeds where ILS and landing approaches are made and all the other touchy work near the ground.

"The rudder has aerodynamic boost and hydraulic boost, but you are not convinced they do much because it takes almost full rudder with an engine out and the forces are enough to make your leg shake. To add problems, using rudder on the swept wing airplane is almost like using aileron. If you push rudder a wing will come right up, so with the touchy ailerons and large amounts of rudder needed you get in busy situations. With an engine out the trick is to shove the rudder the amount needed with a strong, big foot movement and then leave it where you have it and don't feed it in and out. Your leg is straight out and pushing hard.

"It goes like this: Jim cuts number 4 engine, I push in full left rudder and lock my leg in that position. While doing this, of course, I've had some aileron juggling. It's important to keep the ball as near centre as possible and never, right from the start, let skid develop; if too much does develop then rudder effectiveness is lost, you start to use aileron and are soon in a mess. When an engine is cut the trick is to get the needed rudder in fast so the skid doesn't develop.

"The rudder takes so much strength to hold your leg gets cramped and often it's necessary to have the instructor help. This makes a very contrary situation during an ILS. While you have your foot jammed up in one corner pushing hard with a lot of strain, you are also handling the ailerons, to fly the ILS, with safe-cracker finger-tip delicacy. It's like making a concert violinist play some tender piece of music with a ten pound weight on his bow hand.

"One helpful gimmick comes from the excess power. Because of this

First of seven AW.650 Argosies for Riddle Airlines, seen here in flight over Coventry, was due to be exported complete with its FAA certificate of airworthiness last weekend. It was to be flown to Miami from Gatwick by way of the Azores, Gander and Bermuda, the route depending on weather conditions. A new background note to the order appears on pages 959 and 960

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you can set the power differently on each engine and relieve the rudder pressure. But this, of course, means a hand full of unequal throttles and a quick juggling act if you want lots of power in some situation like a pull out.

"If a pilot was down low with rudder held by a straining, shaking leg and he got a charley horse [cramp]—this is easy—and he let the pressure off before his co-pilot could get there to help, the airplane would slew around fast and the possible outcome close to the ground chills the imagination."

Capt Buck goes on to describe the fast footwork that is needed when an engine is cut on take-off and the light touch that is needed to keep down the wing that, with rudder applied, wants to come up. On landing and take-off in a lot of crosswind things can get exciting because of the "touchy" lateral control:—

"In landing you set off the drift and then at the last moment kick her straight with rudder and slide it on. It really works well as long as you remember that when you kick out the rudder a wing will come up and you must be there concurrently with a delicate little twist of aileron. If the twist of aileron isn't delicate you can start the side to side waltz of dutch roll that easily grows in size—at times like this you unhappily remember that the outboard engine pod is less than five feet off the ground!"

HFB 314 ABANDONED

PRODUCTION of the Hamburger Flugzeugbau HFB 314, West Germany's projected Caravelle competitor, has been abandoned because of alleged procrastination on the part of the Federal Ministry of Economics. In a statement the German manufacturer says that it has been for years urging upon the Economics Ministry the necessity for immediate guarantee so that the necessary financing could be arranged. A similar aircraft [D.H.121 Trident] has, they say, been under development in England, but the English designers had been "two years behind the Germans." Because of hesitation on the part of the Economics Ministry, however, this advantage has been lost, and the moment for development of such an aircraft has now passed.

According to a report in *The Times*, the German Government's attitude is that its aircraft industry should not be built up as an independent unit, but that it should co-operate instead with the industries of other countries. Among these, no doubt, is France, a fellow member of the European common market whose aircraft industry is already building and developing an aircraft, the Caravelle, for the same market at which the HFB 314 was aimed. No mention of this has ever been made by Hamburgers.

The most up-to-date facts and figures on the HFB 314 were published in *Flight* for November 18, pages 805 and 813.

CHEAPER TO THE LEVANT

BIG reductions in economy-class return fares between Britain and the Middle East, as agreed at the IATA traffic conference in Cannes last September, are to be introduced by BOAC and their pool partners Qantas and MEA next February. The idea is to stimulate off-season tourism in the Middle East, and a big sales campaign is now under way. It may be recalled that BOAC's main reaction to the conclusion of the IATA conference at Cannes was satisfaction at the achievement of lower tourist fares to the Middle East.

For example, from February to April the economy-class excursion fare from London to Beirut, Cairo and Damascus will be £105, a reduction of 22 per cent on the normal fare of £135. To Amman the fare will be £109 as compared with £140—likewise a 22 per cent reduction. BOAC are also to offer reductions of 15½ per cent on tourist fares between London and Tel Aviv as from next May.

NEW ZEALAND'S LONG-HAUL ASPIRATIONS

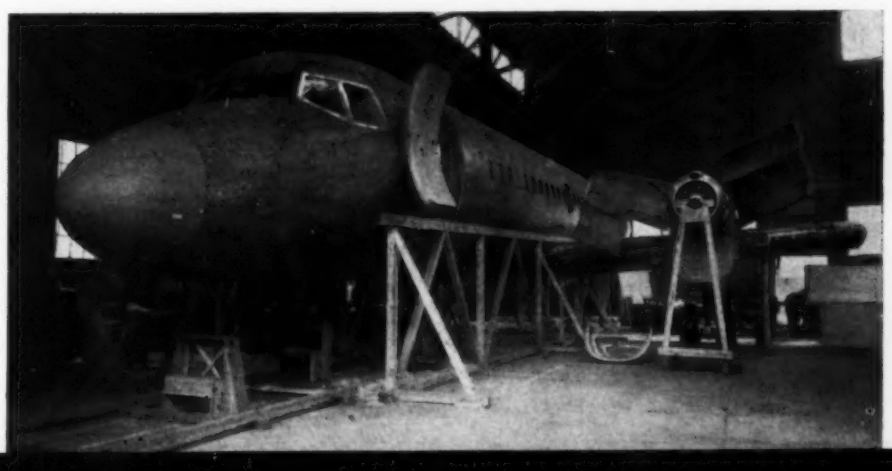
THE busiest over-water air route in the southern hemisphere is probably the trans-Tasman route between Australia and New Zealand operated by TEAL, the airline jointly owned by the governments of Australia and New Zealand. This month TEAL are to increase services between Sydney and Auckland and Wellington, operating 36 flights a week across the Tasman—a route on which passenger traffic has doubled since 1954. The number of passengers is expected to reach a record of 1,000 by the end of 1960.

This news has to be viewed against a background of increasing strain between Australia and New Zealand about the future of TEAL. As already recorded in these columns (*Flight*, August 19, page 284, and September 30, page 548) New Zealanders have aspirations to make TEAL their country's international carrier. During the year the New Zealand Government has been negotiating with France and the USA for traffic rights to permit TEAL to extend its Coral route service to Tahiti, Hawaii and California. This has not been easy, because New Zealand cannot accede to the reciprocal request from the French (TAI) and the Americans (Pan American) for rights to operate across the Tasman without Australia's agreement.

There have been a number of reports that New Zealand wants to buy out the Australian share in TEAL, and the Prime Minister himself, Mr Walter Nash, has said that New Zealand "must have long-distance air services under its control." He has declared that "many New Zealanders . . . are stirred by the prospect of a vigorous developing nation. The Minister in charge of civil aviation and myself are determined that this vision shall be translated into practical terms in the field of New Zealand's civil aviation."

As our Australian contemporary *Aircraft* points out, New Zealand cannot have "long-distance air services under its control" unless it buys out the Australian half-share interest in TEAL. And it cannot gain the rights it wants with that long-distance aim unless it surrenders a share of the trans-Tasman traffic to those countries—traffic which is New Zealand's monopoly and its number one bargaining point.

If ever Australia does agree to sell to New Zealand its share in TEAL, and if New Zealand can find the money, the international aspirations of TEAL can only be fulfilled by re-equipment with new aircraft. It will be recalled that TEAL were very bitter two years ago when, against their better judgment and in deference to Australia's wishes, they re-equipped with Electras. They wanted Comets. Perhaps there might be a market here for the VC10.



Here is the mock-up of the Namco YS-11, the Japanese twin-Dart feederliner for which the Nihon Aeroplane Manufacturing Co of Tokyo, a consortium of Mitsubishi, Fuji, Kawasaki and three other firms, is responsible. The first is due to be completed at the end of 1961, and the first production aircraft is scheduled to operate on Japanese domestic routes during the second half of 1963

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BOEING 727 (continued from page 938)

elimination of yawing tendencies due to asymmetrical power should an engine ever fail." (See Air Commerce, page 960.) On the general case for three engines, Boeing say that a three-engined airliner "can operate under lower visibility and ceiling limitations, which result in better schedule-reliability than is possible under limitations for operation of a twin-engined airplane. Statistical analysis showed that operating from New York International, twin-engined airliners can be expected to be delayed by weather more than one hour 342 times in one year. On the other hand, the Boeing 727's three engines would be delayed only 30 per cent [103] as many times." Another point made by Boeing for the triple-engined arrangement is that "the centre engine can be run to provide air conditioning and electrical power at through stops even during loading and unloading."

Fuselage of the Boeing 727 is basically that of the 707 from the floor up including the cockpit. Window-spacing and size (each window being triple-paned, with two pressurized panes and a light plastic inner pane) is the same as that of the Boeing 720. Boeing put special emphasis on the "luxurious roominess" of the cabin, providing passengers with the "same degree of luxury experienced on the large jets." With Caravelle competition obviously in mind, Boeing emphasize that the 727's cabin makes possible six-abreast seating "which in turn yields 12 per cent greater earnings than five-abreast tourist-class seating." They add that the 12ft 4in wide fuselage increases cost per aircraft-mile by less than one per cent. It will be noted in the table of data on page 938 that the furnished width of the D.H.121's cabin is very nearly as much as that of the Boeing 727.

In an obvious comparison with the Lockheed Electra, Boeing say that direct operating cost per seat-mile is "very nearly the same in first-class configuration as that of the latest American turboprop airliner." In tourist configuration the direct operating cost per seat-mile "is more than ten per cent greater for the [Electra] than for the 727." Average direct cost of flying the 727 on a 500-mile trip is, Boeing say, about $1.50 (10s 8d) per mile.

No Flap-blowing?

No mention is made of previous reports that the 727 is to be fitted with flap-blowing. Perhaps Boeing are keeping an open mind on this point pending the outcome of current tests with the 707 "dash-80" prototype. But the 5,000ft field length with full payload is a remarkable take-off performance for an aeroplane with a power-to-weight ratio (.296) only marginally greater than that of the Trident Mk 1 (.289). According to Mr Wellwood Beall (*Flight*, October 14, page 603), "we are shooting for a C_L of around 2.5, and nobody else is near this." The 727 has triple-slotted trailing-edge flaps and leading-edge flaps and slats. The slats, installed on a Boeing jet for the first time since the XB-47, are of advanced design and extend forward and down from the upper leading edge of the wing at low speeds forming a slot. For cruising flight, the slats retract on to the wing, giving it a leading edge which provides "excellent high-speed characteristics." The leading-edge flaps, inboard of the slats, are similar to those found on the Boeing 720. With low-speed devices retracted, the 727 has the same ratio of span to thickness as the Boeing 707. Again, of course, the 727 take-off should be compared with that of the D.H. Trident Mk 2, which is believed to have a higher C_L derived from slat refinements.

In another obvious reference to the Electra, Boeing say that "at equal gross weights, the 727 will require less CAR field length for take-off than the most modern turbopop powered airplane manufactured in America."

The 727's primary wing structure is of aluminium alloy skin stiffened by stringers, and is claimed to have the aeroelastic properties of the 707, "giving a smoother ride." The two wing spars carry shear loads while skin and stringers carry the major portion of the bending loads. The inter-spar volume of the wing is sealed to provide integral fuel tanks. Fuel lines from tanks to engines run outside the fuselage at cabin floor level and are covered and protected by a fairing.

The vertical fin is 3ft 4in thick, the two-spar structure surmounted by a variable incidence tailplane. Boeing emphasize that the fin is swept sharply aft "to give the control surfaces maximum effect for minimum size and weight. A ventral fin is fitted [this is not shown on the g.a. drawing on page 938] to provide a positive indication of the maximum rotation of the airplane for the shortest take-off distance."

The 727's control system differs from that of the 707 family: whereas the 707 depends on aerodynamic boost to power the ailerons and the elevators, and combined aerodynamic and hydraulic boost for the rudder, the 727 has duplicated hydraulic power to assist aerodynamic movement of the elevator and ailerons throughout the full range of their travel. The rudder is entirely power-operated. However, full manual reversion is possible, and the aircraft can be controlled without any assistance from the hydraulic system should this ever be necessary.

So far as systems are concerned, the 727 is similar to the 707 with identical equipment being used wherever possible. Such changes as have been made were "only on the basis of improvements possible due to experience and to advantages in the state of technology." The electrics are mostly a.c., with d.c. provided through transformer-rectifiers where necessary. Dual air cycle conditioning is employed (as in the 707-720) with pressurized air bled from the engines. The hydraulic system, made up of two separate circuits, provides power for flaps, undercarriage, brakes, nosewheel steering, retraction of passenger stairways at the rear of the fuselage and under the forward passenger entry door, and also the flying controls.

Few Performance Figures

As yet few performance figures have been given. Cruising speed is put as 550-600 m.p.h., stage length as "150-1,700 miles." No Mach number is quoted.

The 727 project is led by Boeing's chief project engineer, Mr Jack Steiner. His team has been guided by "some of the top technical minds in the Boeing organization," namely Mr Edward C. Wells, vp engineering, Mr George Schairer, vp research and development, and Mr Maynard L. Pennell, director of engineering, transport division.

727 Design History

Boeing say that, during the four and a half years in which they have studied the short-haul jet, 68 designs underwent more than 1,500 hours of tunnel testing. Among the projects considered were:—

Model 727-257 This twin-engined project had engines mounted in pods on fuselage-side struts above and behind the wing. This was abandoned in favour of:

Model 727-265, another twin-engined project with the pods mounted conventionally under the wing as in the 707. Analysis of this model, and of another twin-engined project, the

Model 727-264C, which had the engines in pods on either side of the aft fuselage, was followed by studies of all the major US domestic airline routes. In these studies the operational characteristics of twin-engined airliners was "explored in great detail." The economics of a four-engined project that resulted, the

Model 727-475 (called the "720 Junior" by Boeing engineers because of its similarity to that aircraft), were also taken into account. It was determined, say Boeing, that the use of two engines or four engines increased direct cost above that of a three-engined arrangement.

It was on June 1, 1959, that Boeing initiated the full-scale three-engined 727 project. For a year or more the engine most favoured was the RB.163, which was to have been buillt by Allison as the RB.963. According to Mr Wellwood Beall (*Flight*, October 14, page 603), American operators were not happy with this arrangement. He did not think that they liked the divided responsibility and "for them we have prepared a Pratt & Whitney JT8D version even though this engine has a rather larger diameter."

* * *

For the first time the British and American aircraft industries are offering to a potentially very large airline market two transport aircraft which, both technically and in their time-scales, are directly competitive. During the next few years, as the straight fight between the two sways between one and the other, much will be heard of their claimed relative merits. The Boeing 727 is still a brochure, whereas the Trident—though for commercial reasons de Havilland have released no pictures—is in an advanced stage of production. In April '57 Boeing, Convair, Douglas and Lockheed published their proposed target dates for, respectively, the 707, 880, DC-8 and Electra. All of these dates (with the exception of the DC-8's first flight, which was three months behind schedule) were met or—in the case of Boeing—bettered. There is no reason to doubt that Boeing will meet the remarkably early "late 1963" delivery date planned for the 727. Much emphasis will be put by Boeing on the 727's field performance, and also on the ventral passenger door which, it will be argued, the airlines favour, not only because it means six more seats but because it keeps the passenger loading area clear of the cargo-baggage-servicing area during turn-rounds.

On one highly important count at least the D.H.121 is well in advance of its competitor—automatic landing, as is discussed in a further review of the 727 on page 948. J. M. R.

Last week BOAC cargo salesmen attended a special course in London to discuss ways of filling the big increases in freight capacity now being offered by the corporation. The opening of the conference coincided with the inauguration of BOAC's first-ever transatlantic all-freight service with DC-7Fs. Among the BOAC and pool partner representatives attending the course were, left to right: Messrs W. W. Ward, Air-India; E. J. Smith, BOAC; W. Morgan, BOAC; J. Chamberlain, TCA; D. Snell, Air-India; D. McLean, TCA; M. D. Morrissey, BOAC; E. W. Sayers, TCA; J. H. Shaw, BOAC; H. Galbraith, BOAC; and E. Atiyah, BOAC

VC11s FOR TCA?

FOR more than a year now Vickers and TCA have been talking about the VC11, and last week the *Daily Express* reported that Vickers have "won an option" for 20 aircraft. The report actually referred to an option from "an airline," but it is believed that the same newspaper's hint that the airline is, in fact, TCA is correct. BAC last week confirmed that "an airline" has placed an option on "a number less than 20" VC11s.

The Canadian airline has been planning on a large fleet of medium jets—perhaps more than 50—for introduction from 1963-64, and the Convair 600 is one of the contenders that have been carefully considered. Choice by TCA of the VC11 would certainly be a major factor in deciding the British Aircraft Corporation to proceed with the aircraft.

The VC11, according to unofficial figures published in *Flight* for November 18, is a scaled-down VC10 with a maximum weight of about 170,000lb and accommodation for 138 seats plus freight. Powerplant would be four Rolls-Royce RB.163s, and flap blowing is likely to be incorporated.

"STAND-BY POWER" AND SR-426

FOR many years Aerojet-General Corporation have sold certificated rocket units to local-service operators to provide boost propulsion during take-offs in adverse conditions. Such units are particularly valuable to older, piston-engine transports, which otherwise could not operate economically from hot and high airfields. Economic reasons are forcing many airlines to continue to rely on such equipment, and at a recent ATA conference Mr G. Edward Rice, Aerojet's manager of commercial sales, delivered a paper entitled *The Impact of CAR 4b, SR-422 and SR-426 on Local Service Operations.*

After outlining the crippling restrictions imposed by transport-category operating requirements applied to older aircraft, Mr Rice discussed the means whereby the special regulation SR-426 relieved many limitations by providing weight or performance credits for aircraft equipped with "stand-by power" (i.e., FAA-approved rocket boosters). A Martin 404, for example, operating on a standard day from a 4,440ft runway, 8,000ft above sea level, is limited to a weight of 36,500lb; but with stand-by power it could take on 25 more passengers and baggage and operate at 41,500lb—and have better close-in obstacle clearance. Similar improvements are cited for the DC-3, CV-240 and Fairchild F-27. Mr Rice concludes with a brief survey of economic factors, and claims that the amortization of installation costs and the cost of maintaining and carrying stand-by rockets in a given aeroplane is more than covered by an average increase in payload of 200lb.

BREVITIES

According to newspaper reports last week, the Government is to go ahead with its proposal to introduce arrival and departure forms to be completed by passengers leaving and entering Britain by air from points except Europe.

The American Bureau of Sport, Fisheries and Wild Life is trapping 400 seagulls around Logan International Airport, Boston, and dyeing them yellow, purple and green to find out more about the eating and wandering habits of these birds. Helicopters and ground observers will make daily records of the movements of the coloured birds.

The last of TCA's DC-4 "North Stars" has been withdrawn from passenger use though they will continue to carry cargo to and from western Canada until the Vanguards are in service. When the last of the present fleet of 21 North Stars is retired early next year at least one will have flown more than 40,000hr.

The latest addition to the series of Chamber of Commerce booklets is *Goods By Air*, intended as an elementary guide for the businessman who has not previously made use of air transport, as well as forming a handbook for those with some experience. Copies, price 2s 6d post free, from Chamber of Commerce Publications, 68 Queen Street, EC4.

Boeing 707s are to be introduced by BOAC on routes to Europe and the Middle East on January 30. They will operate from London to Teheran via Geneva and Tel Aviv, connecting the Persian capital with BOAC services to the Far East and Australia and in London with the transatlantic service. Hitherto BOAC has operated 707s only across the Atlantic, though from December 8 707 services on the trans-Pacific route to Tokyo and Hong Kong began. BOAC thus now have an all-jet round-the-world service.

Since April 1, 1960, when the BOAC/Qantas/Air-India tripartite pool started, traffic has increased as expected and the planned revenue of some £49½m is likely to be achieved. As reported in *Flight* for October 14, page 623, this revenue is shared in a ratio 51 : 28 : 21.

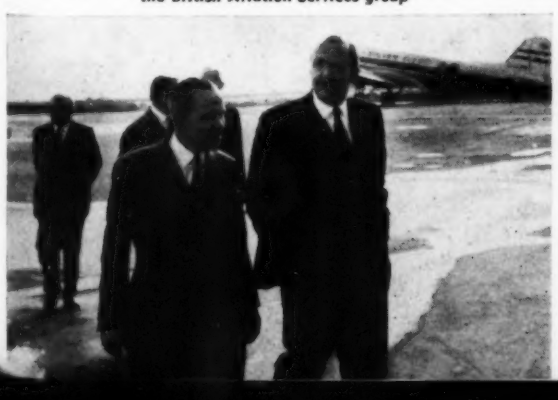
Preliminary estimates of the cost of repairing the SAA Boeing 707 which belly-landed at Nairobi on October 30 is reportedly about £300,000. One of the four engines had to be scrapped and the other three were damaged. The public inquiry in Nairobi is due to begin in a few days' time.

The Minister of Aviation, Mr Peter Thorneycroft, said in the House of Commons last week that he proposes to offer the Princess flying-boats "for sale on the open market." Under questioning, the Minister said he thought that there would be difficulty were the contract to involve the matter of route licences also, and he wanted due notice on this point.

Though not mentioned by name, JP.4 was the subject of a question in the House of Commons last week when Mr John Rankin (Lab, Glasgow, Govan) asked the Minister to give an assurance that JP.4 was not used by foreign aircraft landing in this country. Mr Thorneycroft, who pointed out that he was advised by the ARB in matters of this kind, said he could answer only for aircraft registered in this country.

Commenting on a reported statement by Lord Douglas, chairman of BEA, that Abbotsinch [Glasgow's new airport] would be vacated by the Royal Navy in about a year's time, the Admiralty say that the airfield would be transferred to civil use in about three years' time. "While this will be kept under review," the Admiralty points out, "we can see no prospect whatsoever of vacating Abbotsinch in one year."

A visitor to Silver City's airport at Ferryfield on December 1 was Mr Peter Thorneycroft, Minister of Aviation. Here he is touring the airport with Mr Eoin C. Mekie, chairman and managing director of the British Aviation Services group



Nigeria Airways' interest in the Avro 748 is recorded in this picture of Mr S. L. Edu, their director, discussing the aircraft at A. V. Roe last week. At left is Mr K. Edgerton, Avro chief performance engineer; right, Mr E. Galitzine, sales manager

Last of 30 Bristol Britannias built by Short Brothers and Harland Ltd, a 253, taking off from Sydenham Aerodrome for RAF Lyneham on December 2. The aircraft's log book had been handed over to Gp Capt R. E. Craven, station commander at Lyneham, by Mr R. E. Harvey, joint deputy managing director and general manager of Shorts, who have been responsible for the major design programme involved in converting Britannias for the military role

SERVICE AVIATION

Royal Air Force, Naval and Army Flying News

RAAF Helicopter Squadron

FIRST helicopter unit in the RAAF, No 9 Sqn, is being formed and from next year will be based at Williamtown, NSW. It will have 12 aircraft and their pilots will probably be trained by the Royal Australian Navy. The helicopters will carry out flying activities for both the RAAF and the Australian Army. The type of machines to be used has not yet been officially announced.

For Malayan Service

AWARDS of the Air Force Cross, and Mentions in Despatches, have been announced "in recognition of distinguished service in Malaya." Sqn Ldr Frank Barnes, formerly CO of No 110 Sqn, and Capt John Chandler, who until last May commanded No 7 Reconnaissance Flight of 656 Light Aircraft Sqn, Army Air Corps, have both been awarded the AFC; and Flt Lts A. J. Archibald, RAF Regt, J. D. Bradley, AFC, H. H. J. Browning and H. G. Haines, and M/Plt J. M. McQ. Walker have been mentioned in despatches.

"... souls must be saved"

A QUOTATION from Shakespeare's *Othello* forms appropriate introduction for an account of the RAF helicopter rescue recently off the Cyprus coast, especially as Othello's Tower at Famagusta (reputedly the site of Desdemona's murder) was used as land base for the operation.

Three Sycamores from No 103 Sqn at Nicosia were involved, going to rescue the crew of the Yugoslav motor vessel *Snjeznik*, which had got into difficulties in an attempt to refloat the Japanese m.v. *Nagato Maru*. The helicopter pilots and navigators were Sqn Ldr J. Price (the squadron CO) and M/Nav S. J. Cawthorne, F/Sgt W. Turner and Flt Lt B. W. Gill, Flt Lt J. Kerr and F/Sgt T. Cramp.

To support the operation, an RAF ambulance (with an MO, Flt Lt A. Marks) and a refuelling truck were despatched to Famagusta, and one of the helicopters winched down a French-speaking officer (Flt Lt Harvey Thompson) on to the *Snjeznik* to brief the ship's crew on rescue procedures. Thirteen men were taken off by the Sycamores, the captain and officers electing to stay on board. Unfortunately one of the aircraft, flown by Flt Lt Kerr, struck the mast with one of its rotor blades in the rough conditions and fell into the sea; but both the pilot and F/Sgt Cramp were picked up by one of the other Sycamores.

Gp Capt A. V. R. ("Sandy") Johnstone, who recently relinquished command of RAF Middleton St George (see "In Brief" item), with his successor, Gp Capt F. Rothwell, by the Spitfire 14 which stands at the station entrance

Fighter Command Changes

A RE-ORGANIZATION has taken place in the structure of RAF Fighter Command, which now has two Groups instead of three as previously. These are No 12, with headquarters at Horsham St Faith; and No 13, with headquarters at Leconfield. But from January 1 next year No 13 Group is to be re-numbered as No 11, to preserve the title of the famous formation which faced the full weight of German attacks on south-east England during the Battle of Britain period. The former No 11 Group headquarters, at Martlesham Heath, closed down recently.

AOC-in-C's Count-down

DURING his recent visit to the United States the AOC-in-C Bomber Command, Air Marshal Sir Kenneth Cross, was to see a Thor missile launching by an RAF crew at Vandenberg AFB last Tuesday (December 13). This was one of a series in what is known as the Combat Training Launch Programme, under which every three months a Thor is withdrawn from a Royal Air Force squadron in the United Kingdom for launching from Vandenberg, and replaced by a new missile. A party of about fifty RAF officers and men attend the launch, in this case having come from RAF North Luffenham, Rutland.

IN BRIEF

Admiral Sir Caspar John, First Sea Lord and Chief of the Naval Staff, reviewed the passing-out parade of No 78 Entry at the RAF College, Cranwell, Lincs, last Tuesday.

No 16 Army Light Aircraft Sqn was formed in Australia on December 1 with Bell 47G-2 (Sioux) helicopters and Cessna 180s. The CO is Wg Cdr K. Robertson and the unit (formerly No 16 AOF Flt) has both Australian Army and RAAF personnel, with some Naval instructors. It is described as "a new venture in inter-Service co-operation."

Gp Capt F. Rothwell, who recently took over command of RAF Middleton St George, is at 43 one of the youngest station COs in Fighter Command. He won the DFC while on light bomber operations in North Africa in 1943, from 1954 to 1957 commanded RAF Stradishall and for the past 3½ years has been Air Attaché at Bangkok, Thailand (picture, col 2).

Shackletons from No 206 Sqn at St Mawgan and No 120 Sqn at Kinloss are flying out to the Air Ministry ocean weather ships in the Atlantic next Thursday (December 22) and on Christmas Eve to drop Christmas mail and gifts for the crews. The watertight containers from Kinloss will include two Christmas trees with decorations, and bundles of books and magazines, as gifts from the station.

A Victor made a wheels-up landing on a foam-covered runway at Waddington on December 5. This is the station where a carpet 1,000yd long and 30yd wide can be laid by the "sudsmobile" technique (*Flight*, August 19 and May 6) within half an hour's warning of an attempted belly landing. The system was first used "in anger" (by a Canberra) on August 23. The Victor, a B.2, was on test from the Handley Page airfield at Radlett.

Air Council awards made recently to inventors of devices designed to improve the functioning of RAF equipment include £50 (plus £25 from the AOC-in-C Flying Training Command) to M/Tech T. W. Thomas of RAF Henlow for a modification to Alvis Leonides engines which prevents oil entering the valves controlling the pneumatic system, and £30 to Cpl R. J. Rickards for his design of a test rig for starter circuits of turbine engines.

Readying a Blackburn Buccaneer for take-off during recent Mediterranean trials aboard HMS "Ark Royal." These were flown by two pilots from "C" Sqn, A and AEE, Boscombe Down, and Derek Whitehead, the company's chief test pilot. The aircraft involved were XK489 and XK527, fourth and eleventh Buccaneers to be produced

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